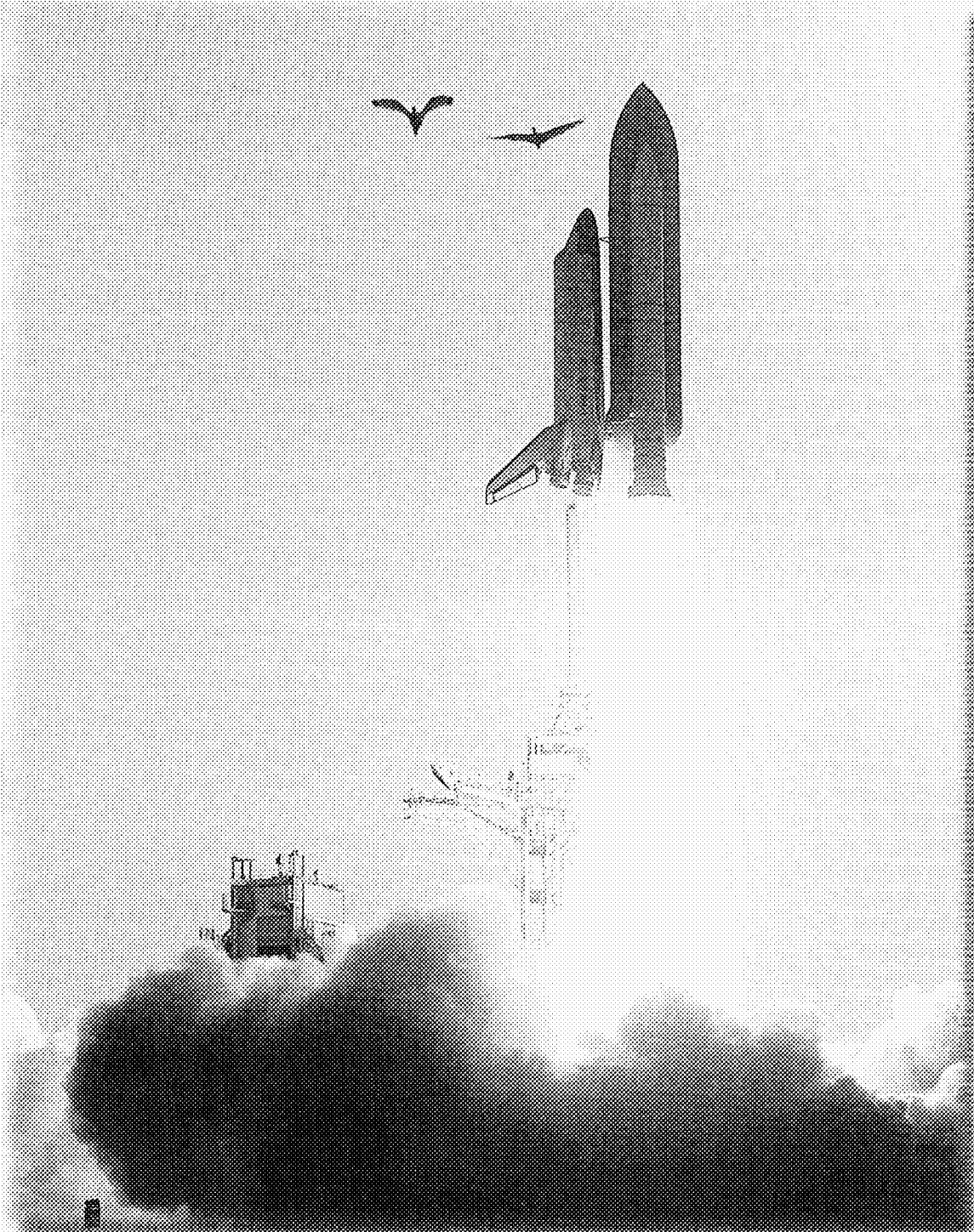












# National Aeronautics and Space Administration



## 1998 Accountability Report

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## About the cover:

Startled by the thunderous roar of the Space Shuttle Discovery's engines as it lifts off, several birds hurriedly leave the Launch Pad 39A at Kennedy Space Center for a more peaceful site. STS-91, the last Shuttle-Mir mission, launched on June 2, 1998.

# Statement of the Administrator

NASA's significant program accomplishments continue, as do its institutional improvements. We are delivering programs faster, better, and cheaper, while making safety our number one priority. Our results come from the hard work of the NASA team: its employees, contractors, academic researchers, industry, government, and international partners. They also depend on the continued support of the President, the Congress, and the public.

Our programs have resulted in new understandings in four strategic areas:

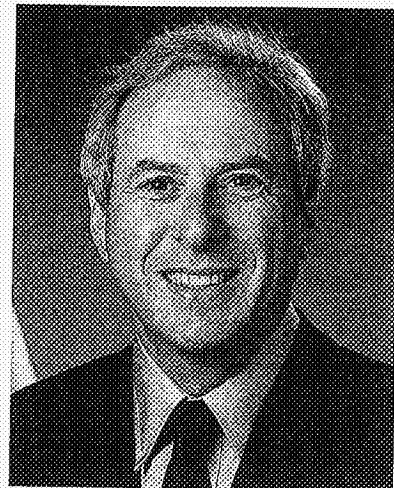
- The Space Science Enterprise studies the origin and operations of the universe. NASA has detected a cosmic gamma-ray burst that released a hundred times more energy than had been theorized previously. The Hubble Telescope has taken the first direct image of what is possibly a planet outside our solar system. The low cost Lunar Prospector has found impressive scientific evidence of ice around the poles of the moon, increasing the possibility of human development.
- The Earth Science Enterprise continues to provide invaluable satellite and aircraft observations that are unraveling the mysteries of Earth system processes. We observed a new record low for ozone concentrations over Antarctica, and have recorded, in unprecedented detail, the structure of the Antarctic ice sheet. We provided dramatic images and data on the systemic action of El Niño on climate and are now tracking its opposite La Niña.
- The Human Exploration and Development of Space Enterprise successfully flew a new, super lightweight, external fuel tank for the Shuttle, allowing increased payloads. NASA and its international partners have overcome obstacles to make substantial progress on the International Space Station, producing over 360,000 pounds of hardware. In October 1998, John Glenn returned to space on the Shuttle, studying the effects of aging and weightlessness. In November and December, the first two elements of the International Space Station, Zarya and Unity, were launched.
- The Aero-Space Technology Enterprise, with the Federal Aviation Administration, demonstrated advanced air traffic control technology that safely increases landing rates by 10 percent during high traffic periods and is now operational at five airports. NASA and its general aviation partners also demonstrated an advanced flat panel cockpit display that improves safety, reliability, and ease of use. Progress on the X-33 Reusable Launch Vehicle technology demonstrator included integration of the liquid oxygen tank, and completion of launch site construction at Edwards Air Force Base.

Our institutional accomplishments have also been significant. We have rebuilt NASA as an institution, achieved more than 85 percent of our planned reduction of 7,500 civil servants, reorganized our Centers around areas of excellence, implemented performance-based contracting across 80 percent of available contract funding, and met severe budget challenges—reducing NASA budget requests on an annual basis.

Looking to the future, we will continue to progress through our Strategic Plan, our reorganization into four programmatically focused Strategic Enterprises, and our realignment of Centers and contractors. We are focusing on fundamental questions in each strategic area, and continuing to streamline and strengthen NASA.

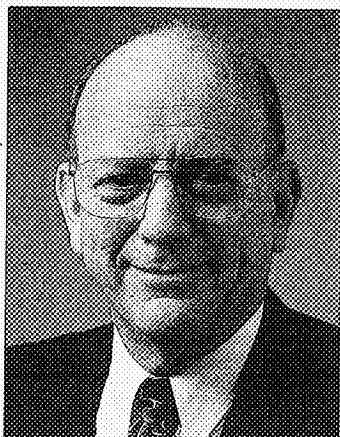


Daniel S. Goldin  
Administrator



Daniel S. Goldin  
Administrator

# Statement of the Chief Financial Officer



Arnold G. Holz  
Chief Financial Officer

As one of the original Federal pilot agencies, NASA has streamlined its reporting by producing Accountability Reports that consolidate reports required by various statutes. This year NASA further improves its reporting by including comprehensive information on the status of its audit follow-up activities.

This Accountability Report summarizes NASA's program accomplishments and its stewardship over budget and financial resources. The Report is the culmination of NASA's management process, which begins with mission definition and program planning, continues with formulation and justification of NASA's budgets for the President and Congress, and ends with NASA scientific and engineering program accomplishments. This Report covers NASA's activities from October 1, 1997, through September 30, 1998, with discussion of some subsequent events.

NASA program accomplishments include the first image of a possible planet around another star and evidence of the largest expanse of Antarctic ozone depletion since records have been kept. Accomplishments are highlighted in the Statement of the Administrator, and summarized in the performance section of this report.

These NASA accomplishments continue in the face of declining budgetary resources. Agency budgets have fallen from a high of 4.4 percent of the Federal budget in the 1960's, to less than one percent of the current Federal budget. NASA has met this budgetary challenge by reorienting programs, eliminating low-priority efforts, reducing support contracts and civil service staffing, and reforming procurement.

NASA is continuing to improve its internal controls, and upgrade and streamline its budget and financial management. NASA's financial management systems have been determined to comply substantially with the requirements of the Federal Financial Management Improvement Act of 1996. This has resulted in the reduction of the only material weakness reported in last year's Annual Statement of Assurance to a significant area of concern. We have also achieved five consecutive years of clean audit opinions on our financial statements.

NASA has made continued progress in the management challenge of implementing the Integrated Financial Management Project (IFMP) system and is extending its full cost approach into program elements. Implementation of the IFMP will allow this technique to provide information to enhance cost-effective mission performance.

Financial statements were prepared in accordance with standards developed by the Federal Accounting Standards Advisory Board (FASAB), and reporting instructions issued by the Office of Management and Budget. In particular, we are proud of achieving a clean opinion again for FY 1998 in view of the difficulty of implementing the numerous changes in accounting standards taking effect this year. Under these changes, NASA financial statements now show the full cost of NASA programs, including depreciation of our property, plant, and equipment; and allocations of common administrative cost.

The preparation of this report required the teamwork and dedicated efforts of NASA's staff and its auditors. We appreciate their dedication and professionalism.

A handwritten signature in cursive script that reads "Arnold G. Holz".

Arnold G. Holz  
Chief Financial Officer

# NASA at a Glance

NASA is a Federal research and engineering agency that accomplishes most of its space, aeronautics, science, and technology programs through field Centers and contractors spread across the United States. The NASA organization consists of approximately 19,000 employees located at Headquarters and nine field Centers. It is supported by the Jet Propulsion Laboratory, a federally funded Research and Development Center. NASA's program and support activities are guided by a comprehensive strategic planning process. NASA's accomplishments have been significant, especially in light of budgetary levels that have continued to decline over the past 10 years.

## Program

The NASA aeronautics and space program consists of a variety of national programs, projects, and activities. NASA has a detailed and comprehensive program, project, and subproject structure. The structure is consistent throughout the Agency and its systems—including both budget and accounting. The management of programs is organized around four Strategic Enterprises:

- ☐ Space Science,
- ☐ Earth Science,
- ☐ Human Exploration and Development of Space, and
- ☐ Aero-Space Technology.

All NASA programs are managed by these Enterprises. For example, Space Science manages the Hubble Space Telescope and the current missions to other planets. Earth Science is responsible for our growing knowledge of the earth as a planetary system. Human Exploration and Development of Space is responsible for the Space

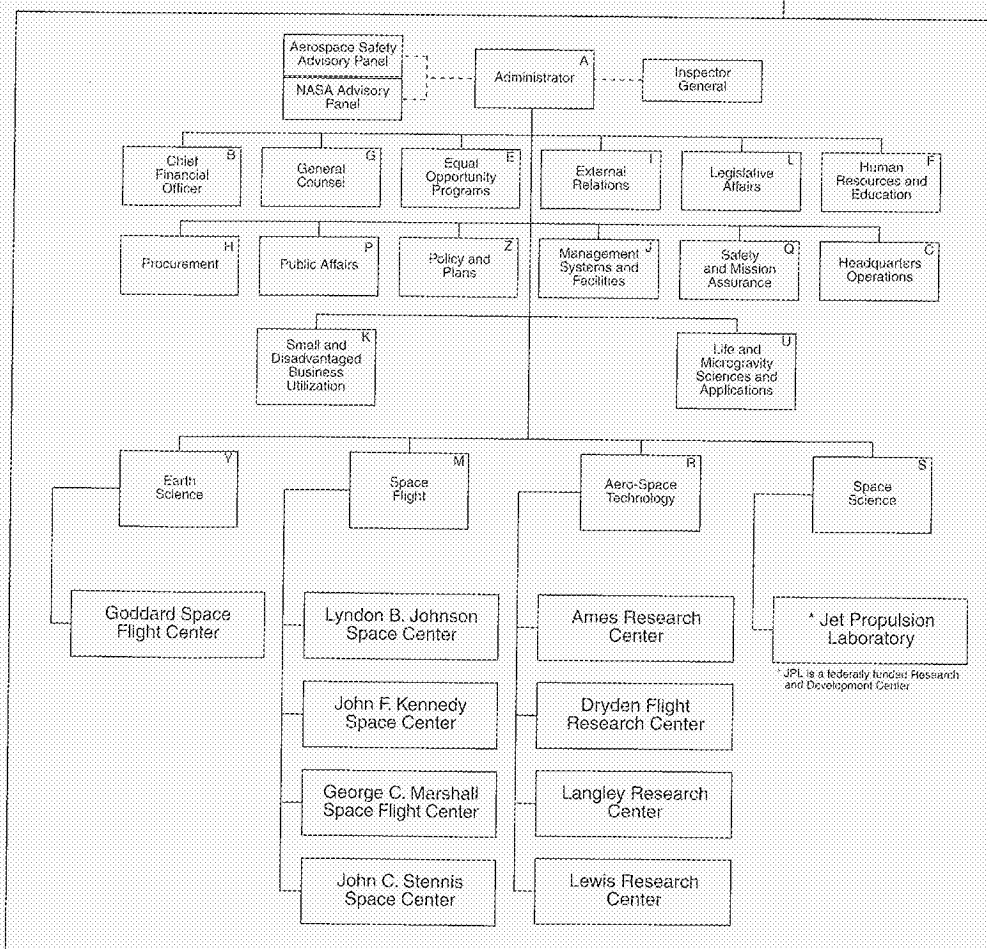
Shuttle and the International Space Station. Aero-Space Technology is responsible for advances in capabilities and the safety of civil aviation, as well as improved access to space.

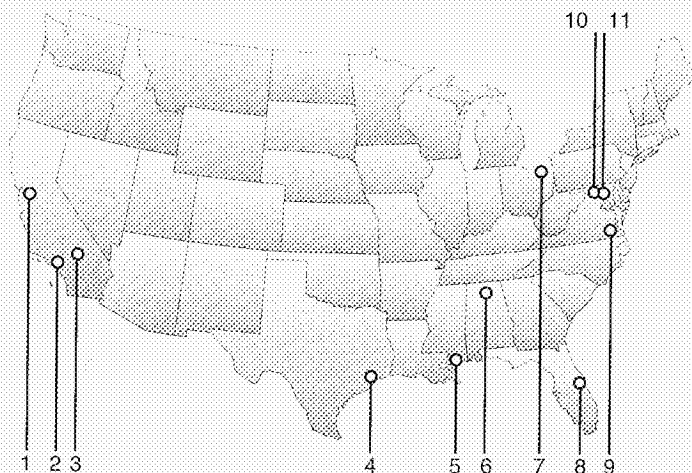
Additional information on NASA programs is contained in the planning and budget section and the performance section of this report. An electronic copy of this report and further detailed information can be found at NASA's website (<http://www.nasa.gov>).

## Organization

The NASA team is a diverse group of men and women at Headquarters and nine Centers. NASA also relies on partnerships with large and small contractors (including the Jet Propulsion Laboratory), members of the academic community, other Federal agencies, State and local agencies, and other space agencies throughout the world.

NASA  
Organization





- |    |                                      |  |
|----|--------------------------------------|--|
| 1  | <b>Ames Research Center</b>          | Information Technology   |
| 2  | <b>Jet Propulsion Laboratory*</b>    | Deep Space Systems   |
| 3  | <b>Dryden Flight Research Center</b> | Atmospheric Flight Operations  |
| 4  | <b>Johnson Space Center</b>          | Human Operations in Space  |
| 5  | <b>Stennis Space Center</b>          | Rocket Propulsion Test and Commercial Remote Sensing                                     |
| 6  | <b>Marshall Space Flight Center</b>  | Space Propulsion Transportation Systems Development, and Optics Manufacturing Technology |
| 7  | <b>Lewis Research Center</b>         | Aeropropulsion and Aerospace Power Systems Research and Technology                       |
| 8  | <b>Kennedy Space Center</b>          | Launch and Payload Processing Systems  |
| 9  | <b>Langley Research Center</b>       | Structures and Materials   |
| 10 | <b>NASA Headquarters</b>             | Agency Management  |
| 11 | <b>Goddard Space Flight Center</b>   | Scientific Research  |

\* A federally funded research and development center

Administrator and work in partnership with Enterprise Associate Administrators and Center Directors to ensure that activities are being conducted in accordance with all statutory and regulatory requirements, including fiduciary responsibilities. They also advise the Administrator and senior managers of potential efficiencies to be gained through Agency-wide standardization and consolidation, and they coordinate the implementation of approved initiatives.

The Office of the Inspector General serves as an independent and objective audit, inspection, and investigative organization by performing audits, reviews, inspections, and investigations. The OIG prevents and detects fraud, waste, and abuse, and assists NASA management in promoting economy, efficiency, and effectiveness in its programs and operations. OIG auditors, evaluators, and agents are located at Headquarters and all NASA Centers.

#### NASA Centers of Excellence

### Headquarters

NASA's Headquarters organization consists of the Office of the Administrator, the four Strategic Enterprises, functional and staff offices, and the Office of the Inspector General (OIG).

The Office of the Administrator directs NASA in carrying out the policies approved by the President and Congress, and overseeing Agency and program management. NASA's four Strategic Enterprises have primary responsibility for strategic goals, objectives, and programs and for serving NASA customers. The Strategic Enterprises also oversee NASA Centers.

Agency functional and staff offices establish and disseminate policy and leadership strategies in their areas of responsibility. As a group, they serve in an advisory capacity to the

### Centers

NASA's scientific and engineering work is largely carried out at its Centers, and at the Jet Propulsion Laboratory. These installations are centers of excellence in various scientific and engineering specialties as well as in their assigned missions. Installations are spread across the United States. Additional NASA work is carried out by off-site contractors, the academic community, and NASA's international partners.

### Planning

NASA has steadily improved its planning and management processes consistent with the Government Performance and Results Act. NASA aligns its organizational and program structure with the requirements of the Agency's customers and stakeholders, and inte-

## NASA Vision

NASA is an investment in America's future. As explorers, pioneers, and innovators, we boldly expand frontiers in air and space to inspire and serve America and to benefit the quality of life on Earth.

## NASA Mission

To advance and communicate scientific knowledge and understanding of the Earth, the solar system, and the universe and use the environment of space for research.

To explore, use, and enable the development of space for human enterprise.

To research, develop, verify, and transfer advanced aeronautics, space, and related technologies.

grates its strategic planning, budgeting, performance management, accounting, and reporting activities.

NASA has developed statements of its vision, mission, and the fundamental scientific and engineering questions addressed by its programs. These statements provide a foundation for NASA goals and objectives.

NASA's vision, mission, goals, and objectives are a product of close collaboration with customers; partner agencies, which are carrying out related programs; and stakeholders in the Administration and Congress. These goals and objectives are supported by the NASA budget described on subsequent pages of this section.

Progress toward the achievement of NASA goals and objectives is described in the performance and crosscutting sections of this document. These sections provide the Agency's detailed performance goals and accomplish-

## NASA Fundamental Questions

1. How did the universe, galaxies, stars, and planets form and evolve? How can our exploration of the universe and our solar system revolutionize our understanding of physics, chemistry, and biology?
2. Does life in any form, however simple or complex, carbon-based or other, exist elsewhere than on planet Earth? Are there Earth-like planets beyond our solar system?
3. How can we utilize the knowledge of the Sun, Earth, and other planetary bodies to develop predictive environmental, climate, natural disaster, and natural resource models to help ensure sustainable development and improve the quality of life on Earth?
4. What is the fundamental role of gravity and cosmic radiation in vital biological, physical, and chemical systems in space, on other planetary bodies, and on Earth, and how do we apply this fundamental knowledge to the establishment of permanent human presence in space to improve life on Earth?
5. How can we enable revolutionary technological advances to provide air and space travel for anyone, anytime, anywhere more safely, more affordably, and with less impact on the environment and improve business opportunities and global security?
6. What cutting-edge technologies, processes, and techniques and engineering capabilities must we develop to enable our research agenda in the most productive, economical, and timely manner? How can we most effectively transfer the knowledge we gain from our research and discoveries to commercial ventures in the air, in space, and on Earth?

ments for each Strategic Enterprise and for the Agency's four crosscutting processes.

NASA delivers its products and services to customers through work processes that cut across the agency's Enterprises and functional/staff offices. These crosscutting processes include strategic management, providing aerospace products and capabilities, generating knowledge, and communicating knowledge.

Details are available in NASA's Strategic Plan at NASA's website (<http://www.nasa.gov>).

In addition to this plan, the Office of the Inspector General (OIG) has its own Strategic Implementation Plan. Each program area (i.e., Audits, Investigations, and Inspections) is currently preparing a more detailed implementation plan, including appropriate metrics. Annually, the OIG will prepare and submit to the President and Congress a performance plan and report on its accomplishments.

## Budget

The Agency budget for the past three years has averaged approximately \$13.7 billion per year. NASA currently receives its funding through the following appropriations:

- ❑ **Human Space Flight**—This appropriation provides for the International Space Station and Space Shuttle programs, including flight support for cooperative programs with Russia and other nations.
- ❑ **Science, Aeronautics, and Technology**—This appropriation provides funding for various research and development activities: Earth and Space Science, Aeronautics, Life and Microgravity Science, Technology Investments, Education Programs, and Mission Communication Services.
- ❑ **Mission Support**—This appropriation provides

funding for space communication services, safety and quality assurance activities, facilities maintenance and construction activities to preserve the Agency's core infrastructure, environmental remediation, and NASA's civil service workforce.

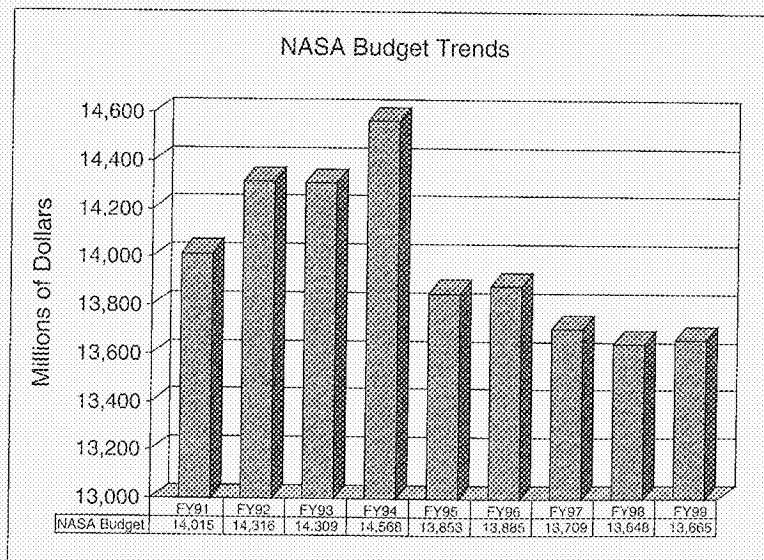
- ❑ **Inspector General**—This appropriation provides funding for the staffing and support required to perform audits, evaluations, and investigations of NASA's programs and operations.

## NASA Budget Trends

NASA's share of Federal spending has declined from a high of 4.4 percent of the Federal budget in 1966, at the height of the Apollo program, to about 0.7 percent currently. Over the past 10 years, the NASA budget has continued to decline, as shown in the graphic "NASA Funding Trends." NASA continues to make important scientific and engineering advances with less resources.

## Recent Program Trends

In the face of declining budgets, NASA has made changes in program emphasis during the last few years. The Agency has reoriented its budgets consistent with its strategic planning and its missions—explore, use, and enable the development of space; advance scientific knowledge; and research, develop, verify, and transfer space-related technologies. Its declining



resources have been allocated to its mission-related top priorities: safe operation of the Space Shuttle, development and operation of the International Space Station, and maintaining a strong program of science and technology development.

## How NASA Spends Its Budget Resources

In accomplishing its programs, NASA spends the greatest part of its resources (approximately 75 percent) through contracts for a wide variety of programs for related support and services, and the acquisition of capital assets. NASA also supports a civil service workforce and spends significant resources through grants, principally research grants with colleges and universities. NASA also provides a variety of reimbursable programs to Federal, commercial, and international agency customers.

## NASA Budget Request for FY 2000

NASA's budget request for FY 2000 reaffirms NASA's commitment to a balanced aeronautics and space program. NASA's priorities include a

commitment to safety for human aeronautics and space flight, the assembly of the International Space Station, and the development of the Next Generation Launch Vehicle. The budget also provides support for an aggressive space science program, a program of long-term observation, research, and analysis of Earth from space, and revolutionary advancements that will sustain global U.S. leadership in civil aeronautics and space. NASA has taken steps to minimize support costs by implementing recommendations from the 1995 NASA Zero Base Review, while focusing on low-cost/high-payoff missions to maximize the Agency's output from a decreasing budget base.

Under the current appropriations structure and that for FY 2000, the Mission Support appropriation carries a portion of the direct support required to execute Enterprise programs. This includes research and operations support and civil service salaries and travel. As NASA moves into the era of full cost management, the budget for these supporting elements is expected to be directly allocated to programs and projects.

# Space Science

## Mission and Questions

The Space Science Enterprise (SSE) serves the human quest to understand our origin, our existence, and our fate. Broadly stated, the SSE mission is to solve mysteries of the universe, explore the solar system, discover planets around other stars, and search for life beyond Earth. In pursuing this mission, we develop, use, and transfer innovative space technologies that support all of NASA's Enterprises and contribute to the Nation's global competitiveness. We provide scientific support to NASA's human exploration program, and use our knowledge and discoveries to enhance science, mathematics, technology education, and the scientific and technological literacy of all Americans.

Fundamental questions for the SSE are:

- ☐ How did the universe begin and what is its ultimate fate?
- ☐ How do galaxies, stars, and planets form and evolve?
- ☐ What physical processes take place in extreme environments such as black holes?
- ☐ How and where did life begin?
- ☐ How is the evolution of life linked to planetary evolution and to cosmic phenomena?
- ☐ How and why does the Sun vary and how do the Earth and planets respond?
- ☐ How might humans inhabit other worlds?

## Goals and Objectives

In carrying out its mission, the SSE's four long-term goals are as follows:

- ☐ establish a virtual presence throughout the solar system, and probe deeper into the

mysteries of the universe and life on Earth and beyond—a goal focused on the fundamental science we will pursue;

- ☐ pursue space science programs that enable and are enabled by future human exploration beyond low-Earth orbit—a goal exploiting our synergy with the human exploration of space;
- ☐ develop and utilize revolutionary technologies for missions impossible in the past—a goal recognizing the enabling character of technology; and
- ☐ contribute measurably to achieving the science, mathematics, and technology education goals of our Nation, and share widely the excitement and inspiration of our missions and discoveries—a goal reflecting our commitment to education and public outreach.

SSE's near-term objectives are identified in the Space Science Roadmap in the NASA Strategic Plan, NPD-1000.1, and are elaborated in the 1997 Space Science Enterprise Strategic Plan. As described in these plans, we pursue these objectives through a comprehensive and balanced program of space science flight missions, technology development, and supporting scientific research.

## Accomplishments and Performance Measures

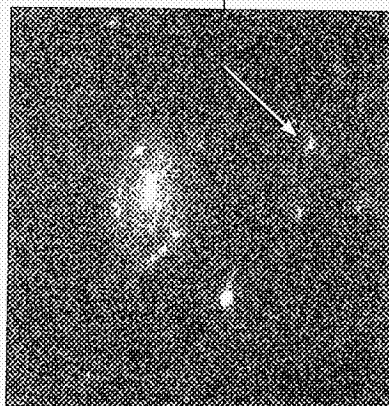
In 1998, Space Science had an outstanding year of discovery. Highlights included the detection of a cosmic gamma-ray burst that released a hundred times more energy than previously theorized, making it the most powerful explosion since the detection of the Big Bang. See "An Enormous Burst Detected."

The Hubble Space Telescope provided the first direct image of what is possibly a planet outside our solar system—one that apparently has been ejected into deep space by its parent stars. See "A Runaway World?"

Data returned by the Lunar Prospector spacecraft shown below suggests there is a high

Top:  
An Enormous  
Burst Detected

Bottom:  
A Runaway  
World?



probability that water exists at both the north and south poles of the moon. See "Water on the Moon?"

A neutron star, located 40,000 light years from Earth, is generating the most intense magnetic field yet observed in the Universe, according to an international team led by NASA scientists. See "Artist's Concept of a Magnetar."

The first images from NASA's Transition Region and Coronal Explorer (TRACE) spacecraft, launched in April 1998, reveal activity in the solar atmosphere in stunning detail and include the first detailed observations of a magnetic energy release (called a magnetic reconnection). See "TRACE Image of Solar Activity."

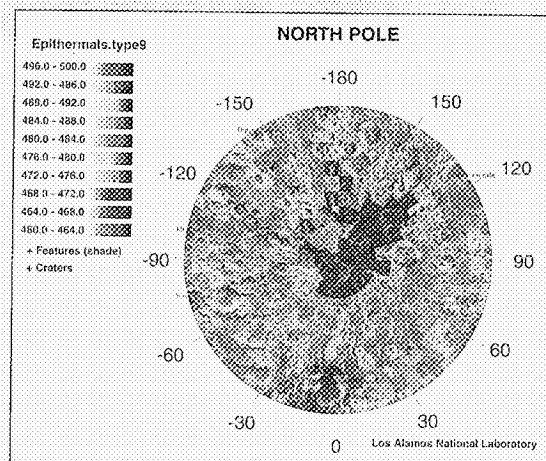
In FY 1998, SSE also had notable success in other missions. The Deep Space 1 spacecraft was launched and successfully demonstrated the use of ion propulsion engines for planetary missions, as one of several novel technologies. The Galileo spacecraft amassed growing evidence of a subsurface ocean on Jupiter's moon Europa, as well as (for the first time) on Callisto. The Mars Global Surveyor spacecraft, while not yet in its final mapping orbit, has returned many stunning preliminary images and results. From large missions like the Hubble Space Telescope to small new missions like the university-built and operated Student Nitric Oxide Explorer, the Space Science program has continued to generate exciting discoveries, helping to answer some of humanity's oldest and deepest questions.

The SSE tracks program-wide performance measures for several project-related areas: annual flight rate, spacecraft development time, development cost, and total program cost versus commitment. Activities in these areas

support all of the scientific objectives of the Enterprise, and performance in them reflects the Enterprise's strategy to "sustain an aggressive program of discovery while using lower cost missions." Further, near-term SSE objectives support the Agency near-term goal, as depicted in the NASA Roadmap, "to use low cost missions to chart the evolution of the Universe, from origins to destiny, and understand its galaxies, stars, planets, and life" and "develop robotic missions as forerunners to human exploration beyond low-Earth orbit." These metrics specifically address the NASA strategy as noted in the NASA Roadmap for the 1998-2002 time-frame to "deliver world-class programs and cutting edge technology through a revolutionized NASA."

### Program Cost Status versus Cost Commitment Performance Measure

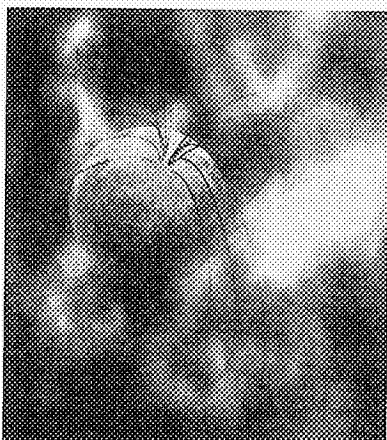
This measures the annual estimated cost of major missions in development versus commitment to Congress. A gauge of success in meeting cost performance commitments for major development programs within the Enterprise, this measure is the ratio of the present budget estimates compared to the commitments made by the Agency to Congress on the maximum cost for each major SSE spacecraft. The commitment to Congress is established at the time the program moves from planning and design into development. The goal of this performance measure is to remain below 100 percent, demonstrating that the SSE is doing better than its commitments to Congress in holding down the cost of major spacecraft.



Top:  
Water on the Moon?

Bottom Left:  
Artist's Concept of a  
Magnetar

Bottom right:  
TRACE Image of Solar  
Activity

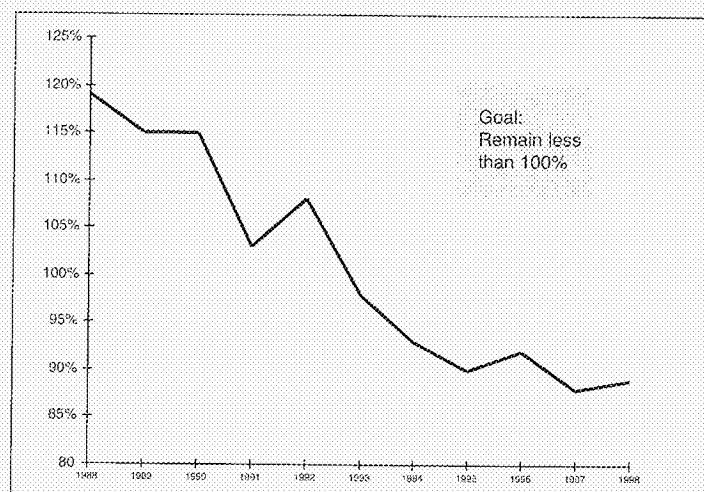


This area has shown continued improvement in recent years; many larger missions that exceeded their cost commitments have been launched, while most of our recent missions are being completed within

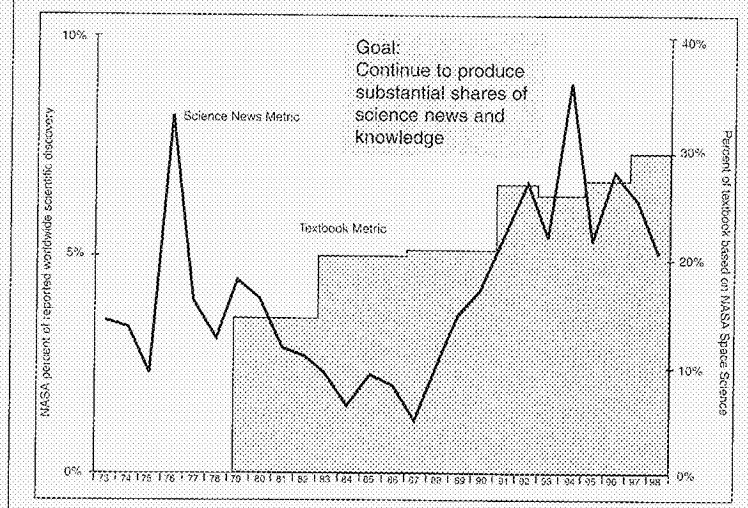
or under commitment. For FY 1999 through FY 2000, we expect that our actual performance on this metric will likely stay between 90 and 100 percent. In 1998, the average cost of major Space Science missions in development was estimated to be 90 percent of commitments to Congress, an excellent performance rating. See "Program Cost Status Versus Commitment."

In addition to science and mission goals, SSE also tracks its ongoing performance in providing benefits to society, including public science awareness and post-secondary education.

Program Cost Status Versus Cost Commitment



Providing Benefits to Society



## Providing Benefits to Society Performance Measure

The SSE will continue to use our knowledge and discoveries to enhance science, mathematics, and technology education and the scientific and technological literacy of all Americans. This objective contributes to the achievement of the Agency goal in the NASA Roadmap to "share new knowledge with our customers and contribute to educational excellence." Furthermore, this objective responds specifically to the NASA Mission to advance and communicate scientific knowledge and understanding. Two metrics are tracked as general indicators of success in this area: a measure of the percentage of the year's most noteworthy science achievements that is attributable to SSE programs, and a measure of the educational impact of NASA's science contributions at colleges and universities across the Nation. Performance on these metrics is best assessed by looking at long-term trends. The goal of these metrics is for NASA to continue to produce a substantial share of science news and textbook contributions.

The science impact measure is based on *Science News* magazine's end-of-year summary of approximately 150 "most important stories" from all fields of science. By the level of its contribution to this independent ranking of science results, SSE's work can be compared to NASA's historical performance and to current worldwide scientific output in terms of relevancy and interest to the public. In 1998, Space Science accounted for five percent of the "most important stories," well above the historical average.

The educational impact measure is based on the percentage of NASA's contribution to a leading college space science textbook (*Astronomy: From the Earth to the Universe* by Jay Pasachoff) over time (from 1975 to 1996). This metric provides an independent indication of NASA's contributions to the educational needs of students. With no new edition this year, this metric of NASA's contribution remains at 30 percent. See "Providing Benefits to Society."

# Earth Science

## Mission and Questions

Over the past 15 years, scientists have begun to see the Earth as an intricately coupled system involving the interactions of land, oceans, ice, atmosphere, and life. As we have begun to integrate large global data sets—many derived from satellites—the linkage among natural phenomena has become more apparent. Evidence of human activities affecting these phenomena is also observed. Thus, a new interdisciplinary field of Earth System Science was created.

NASA's Earth Science Enterprise (ESE) brings space technology to bear on the study of our home planet. The mission of the ESE is to understand the total Earth system, and the effects of natural and human-induced changes on the global environment. ESE addresses most directly two of the six fundamental questions NASA has established to focus its activities:

- How can we utilize the knowledge of the Sun, Earth and other planetary bodies to develop predictive environmental, climate, natural disaster, resource identification, and resource management models to help ensure sustainable development and improve the quality of life on Earth?
- What cutting edge technologies, processes, and techniques and engineering capabilities must we develop to enable our research agenda in the most productive, economical, and timely manner? How can we most effectively transfer the knowledge we gain from our research and discoveries to commercial ventures in the air, in space, and on Earth?

## Goals and Objectives

In concert with its partner agencies here and abroad, ESE provides the scientific foundation required to inform the complex choices to be made by the public and private sectors on the road to sustainable development. ESE has established these goals and objectives to fulfill its mission:

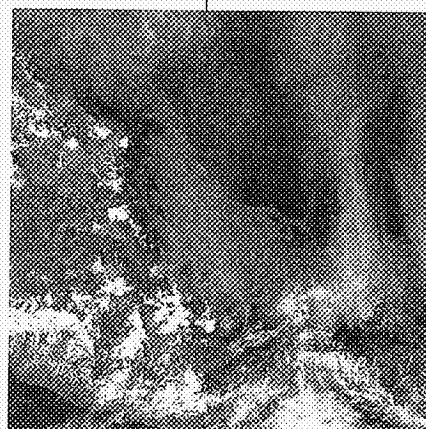
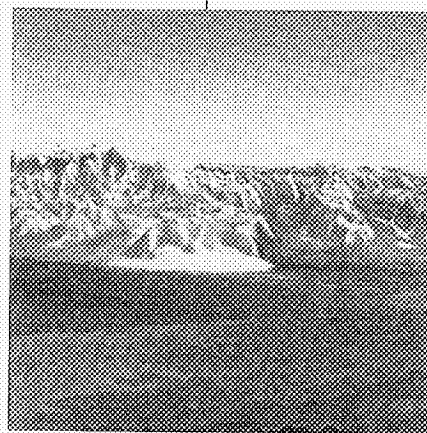
- expand scientific knowledge of the Earth system using NASA's unique capabilities

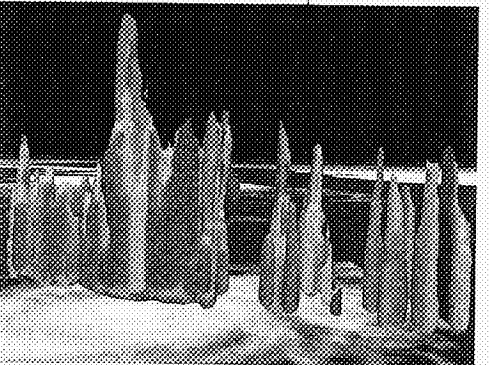
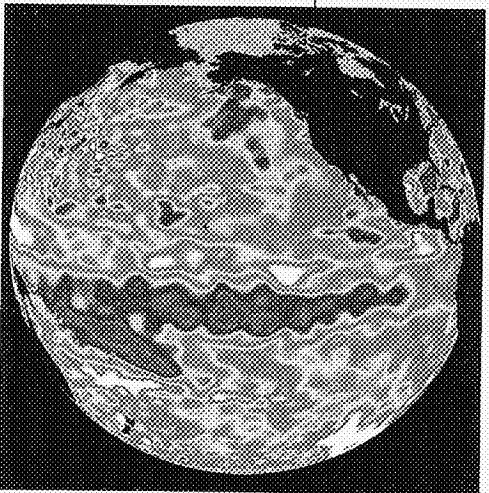
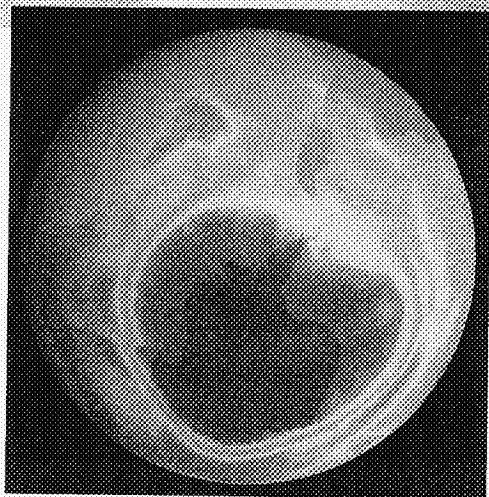
from the vantage points of space, aircraft, and *in situ* platforms;

- observe and document land cover and land use change and impacts on sustained productivity;
- develop and improve the capability to predict seasonal-to-interannual climate variability;
- understand Earth system processes to better predict natural hazards and mitigate natural disasters;
- understand the causes and impacts of long-term climate variations on global and regional scales;
- understand the concentrations and distributions of ozone in the stratosphere and troposphere;
- disseminate information about the Earth System;
- implement open, distributed, and responsive data system architectures;
- increase public understanding of Earth System Science through education and outreach;
- enable productive use of ESE science and technology in the public and private sectors;
- develop and transfer advanced remote sensing technology;
- extend the use of ESE research to national, State and local applications;
- support the development of a robust commercial remote sensing industry;

Top:  
Radar Satellite Image of  
Antarctic Ice Sheet

Bottom:  
SeaWiFS View of  
1998 Fires in Mexico





Top:  
TOMS View of  
Antarctic Ozone Hole

Middle:  
Topex/Poseidon View  
of Fading El Niño

Bottom:  
TRMM-3D Visualization  
of Hurricane Bonnie

■ make major scientific contributions to national and international environmental assessments.

## Accomplishments and Performance Measures

In 1998, ESE continued to provide invaluable satellite and aircraft observations and sponsor research which are unraveling the mysteries of key Earth System processes. A few key examples are:

□ Data from the Antarctic Mapping Mission conducted jointly with the Canadian Space Agency's Radarsat satellite has been processed over the past year, revealing the structure of the Antarctic ice sheet in detail never before possible. These data are enabling scientists to map ice floes in the interior of the icy continent and detect ice calving at its shores. A subsequent mapping mission planned for next year will enable researchers to study changes over time, allowing them to estimate rates of change. See "Radar Satellite Image of Antarctic Ice Sheet."

□ The Sea-viewing Wide Field-of-View Sensor (SeaWiFS) instrument, a pilot NASA/commercial partnership in which the Agency purchases data from a commercial satellite supplier, is exceeding expectations for its utility. Planned as a sensor to detect phytoplankton concentrations ("ocean color"), SeaWiFS is returning surprisingly detailed land and atmosphere images as well. Here, smoke plumes from the Summer 1998 fires in Mexico are clearly visible. Data from SeaWiFS and other sensors are being combined to monitor regional-scale fires around the world, including those in 1998 in Indonesia, Africa, and Russia. See clouds

and smoke in "SeaWiFS View of 1998 Fires in Mexico."

□ The Total Ozone Mapping Spectrometer (TOMS) instrument is the world's premier sentinel for global ozone concentrations. In 1998, new record lows were seen for ozone concentrations over Antarctica during its traditional August–October annual decline. Unprecedented international steps to reduce the emissions of ozone-depleting chemicals are working, as evidenced by declining concentrations of these chemicals in the upper atmosphere. However, because of the long life of these chemicals in the atmosphere, it will be decades before annual ozone lows return to their natural levels. See "TOMS View of Antarctic Ozone Hole."

□ The 1997–98 El Niño was the largest since 1982–83, and one of the largest on record. The U.S./France TOPEX/Poseidon mission allowed the world to watch the birth, development, and dissipation of El Niño as it moved across the Pacific Ocean. TOPEX/Poseidon, a radar altimeter which measures variation in sea surface height to within five inches, is now watching to see if a La Niña event, the opposite of El Niño, is developing. See "Topex/Poseidon View of Fading El Niño."

□ The U.S./Japan Tropical Rainfall Measuring Mission (TRMM), launched in November 1997, is returning remarkable data on global rainfall and lightning. Its Lightning Imaging Sensor showed that the vast majority of lightning strikes occur over land. TRMM is enabling the study of the 3-D structure of tropical storms such as Hurricane Bonnie. Such studies will lead to future improvements in storm movement prediction. More broadly, TRMM is measuring the total rainfall over the tropics, a measurement never before possible. Rainfall is the key to the global "heat engine"—the transport of energy through the atmosphere—which is essential to our understanding of global and regional climate change. See "TRMM 3-D Visualization of Hurricane Bonnie."

The ESE tracks three types of program-wide performance measures. First, it tracks how well

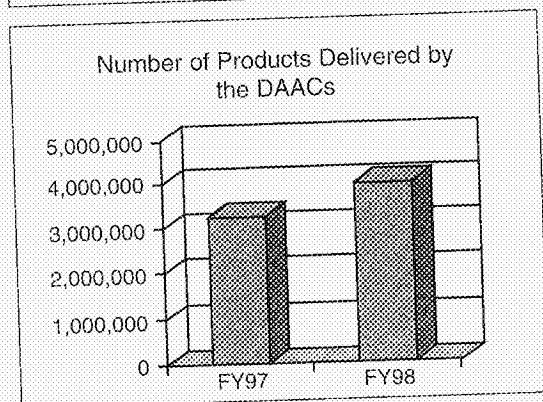
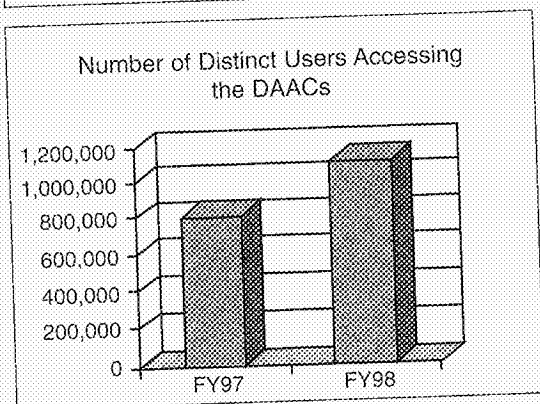
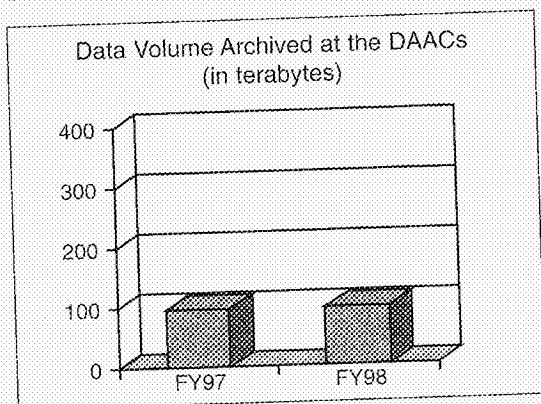
it makes data available to scientists. Second, it tracks its contribution to Earth Science education. Third, it tracks the practical application of its research.

### Data Made Available to Scientists Performance Measures

NASA tracks three performance measures regarding ESE's first line customers, the scientists and others who use Earth Science data products. Accordingly, ESE is making a substantial investment in data and information services to make these data products readily

accessible. Science data products are made accessible through a set of Distributed Active Archive Centers (DAACs). For 1998, NASA has achieved its goal of continued increases in these measures.

- ❑ 184 terabytes of data have been archived. See "Data Volume Archived at the DAACs."
- ❑ 1,049,019 users have accessed the DAACs. See "Number of Distinct Users Accessing the DAACs."
- ❑ 4,511,353 data products have been delivered to users. See "Number of Products Delivered by the DAACs."



### Education in Earth Sciences Performance Measures

Education in the Earth Sciences is one of the key products of the ESE. ESE uses its extensive and growing collection of science data and research results to develop new educational products and to support curriculum development and teacher training.

- ❑ ESE has an annual target of sponsoring at least 300 workshops to train teachers in the use of ESE education products; in FY 1998, ESE sponsored 410 workshops.
- ❑ ESE has an additional annual target of awarding 50 new graduate student research fellowships; in FY 1998 ESE awarded 52.
- ❑ ESE is a key participant in the Global Learning Observations for a Better Environment (GLOBE) program which involves schools in collecting temperature, precipitation, and related data around the world. The number of participating schools in FY 1998 was 5,400, and the number of participating countries was 70.

### Practical Applications of Earth Science Performance Measures

ESE also has an interest in seeing that the results of its research result in practical applications in the U.S. economy. To this end, the Commercial Remote Sensing Program at NASA's Stennis Space Center works with U.S.

industry to help them become both suppliers and users of remote sensing data. The goals of these performance measures are to increase the number of customers buying Earth Science data on a commercial basis and to increase the number of partnerships with outside entities for using Earth Science information.

- ❑ ESE selected five companies from whom to acquire science data on a commercial basis (implementing a \$50 million science data purchase program).
- ❑ ESE's Commercial Remote Sensing Program is engaged in 37 partnerships with commercial entities for the development of "value-added" remote sensing information products.

# Human Exploration and Development of Space

## Mission and Questions

The mission of the Human Exploration and Development of Space (HEDS) Enterprise is to open the space frontier by exploring, using, and enabling the development of space and to expand human experience into the far reaches of space.

In exploring space, HEDS brings people and machines together to overcome challenges of distance, time, and environment. Robotic science missions survey and characterize other bodies as precursors to eventual human missions. The Space Shuttle and the International Space Station (ISS) serve as research platforms to pave the way for sustained human presence in space through critical research on human adaptation. These programs also provide opportunities for research with applications on Earth. HEDS serves as a catalyst for commercial space development. We employ breakthrough technologies to revolutionize human space flight.

HEDS pursues the answers to myriad research and engineering questions that must be answered as we learn to live and work in space. HEDS plays an important role in pursuing answers to questions, including:

- ❑ What is the fundamental role of gravity and cosmic radiation in vital biological, physical, and chemical systems in space, on other planetary bodies, and on Earth, and how do we apply this fundamental knowledge to the establishment of permanent human presence in space to improve life on Earth?

HEDS also plays an important role working with the other Enterprises to pursue answers to other fundamental questions, including:

- ❑ Does life exist elsewhere than on our planet?

## Goals and Objectives

HEDS has the following long-term goals:

- ❑ expand the frontier;
- ❑ expand knowledge;

- ❑ enable and establish a permanent human presence in Earth orbit;

- ❑ expand the commercialization of space; and

- ❑ share the experience and discovery of human space flight.

HEDS near-term objectives are identified in the HEDS Roadmap in the NASA Strategic Plan (<http://www.nasa.gov>).

## Accomplishments and Performance Measures

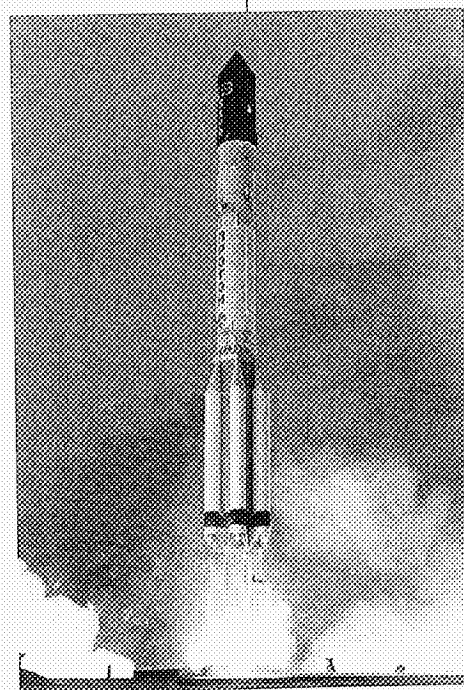
### International Space Station

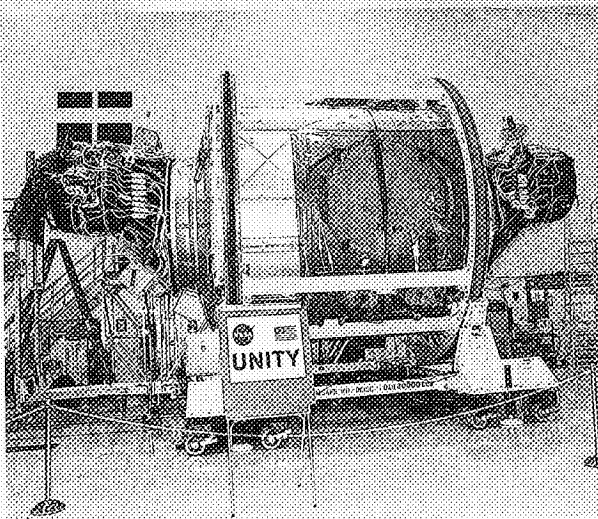
The United States and its international partners (Canada, Europe, Japan, and Russia) have made significant progress in the design and development of the International Space Station (ISS). During FY 1998, the program continued its peak period of hardware and software development, and test and integration activities. The development and delivery to the launch site of the ISS elements for the first six flights is largely complete, and we are doing multi-element integration testing (MEIT) and qualification testing. Through FY 1998, we have produced over 360,000 pounds of hardware and by the close of FY 1999, we will have produced over half a million pounds of hardware.

The first flight element of the International Space Station, the U.S.-funded/Russian-built control module "Zarya" (Dawn) was launched from the Baikonur Cosmodrome on November 20, 1998. See "Zarya Launch."

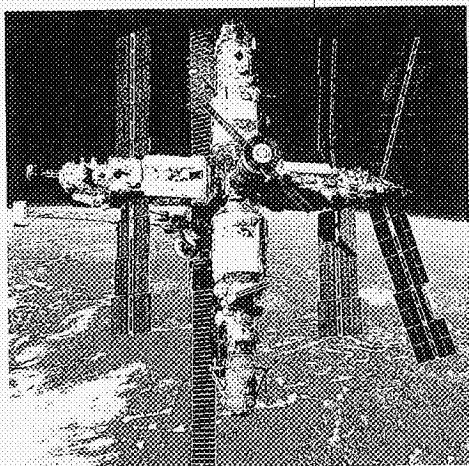
The "Unity" Node and Pressurized Mating Adapters 1 and 2 (PMA-1 and PMA-2) were launched

Zarya Launch





from the Kennedy Space Center on December 3, 1998. See "Unity Node at Kennedy Space Center."



Top Left:  
Unity Node at  
Kennedy Space Center

Bottom Left:  
Mir Space Station

Right:  
STS-91 Landing  
at KSC

Flight 5A, the U.S. Laboratory, continues to be our most significant challenge. The Lab has been delivered to the launch site and the MEIT was completed in November 1998.

Although significant progress was made during FY 1998, major issues continued for program management and NASA management. The ongoing Russian funding shortfall in FY 1998 has evolved into a systemic problem that NASA cannot address unilaterally. The Government of

Russia has continued to experience considerable difficulty in making funds available—in total and on a timely basis—to the Russian Space Agency to enable on-schedule compliance with the ISS program milestones. Although the current planning reflects launch for the initial two U.S. elements, Zarya and Unity, the estimates took into account a four-month delay in the Russian service module (SM) to July 1999 and a one-year stretch-out of the assembly sequence. This stretch-out is due to an assumed under-support of Russian Progress launches, and the addition of a U.S. propulsion capability, both of which add Shuttle flights to the assembly sequence. NASA has developed a comprehensive plan which would allow it to move the ISS program forward, maintain the Russian partnership based upon their economic ability, and achieve greater U.S. backup capability over the next several years.

## Space Shuttle

The Space Shuttle program goal is to provide safe, reliable, and affordable access to space. The Shuttle is the only U.S. vehicle that provides human transportation to and from orbit. In FY 1998, 28 crew members spent approxi-

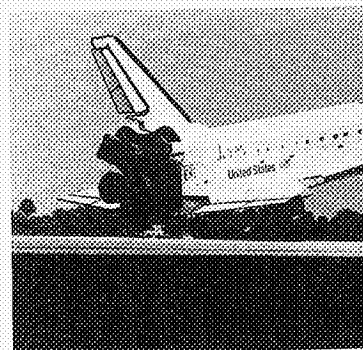
mately 605 crew-days in orbit, including time spent by American astronauts aboard Mir.

The priorities of the Space Shuttle program are to: (1) fly safely, (2) meet the flight manifest, (3) improve mission supportability, and (4) continuously improve the system. These goals are reflected in program decisions regarding flight requirements, programmatic changes, and budget reductions. The nominal flight rate for the program continues to be budgeted at an average of seven flights annually; however, only four Space Shuttle flights were launched in FY 1998 instead of the six that were planned. Due to a production lag in an ISS component to be provided by our Russian partner, the first Space Shuttle launch of ISS hardware was delayed until FY 1999. Also, due to problems in delivery of NASA's Advanced X-ray Astronomy Facility (AXAF) payload, this Space Shuttle flight was also delayed to FY 1999.

The Space Shuttle continues to prove itself to be the safest and most versatile space flight vehicle ever built. In FY 1998, the Space Shuttle successfully completed two flights to the Russian Mir Space Station including the ninth, STS-91, and last of its planned rendezvous missions to Mir. See "Mir Space Station."

This milestone marked the completion of Phase 1 of the ISS program. On this same mission, the Shuttle carried into orbit the Alpha Magnetic Spectrometer (AMS) payload. The AMS found and measured high energy charged particles including antiprotons. These results will potentially revolutionize our understanding of basic physics and help increase our understanding of the composition and origin of the universe. See "STS-91 Landing at KSC."

The Space Shuttle program is flying more safely and at lower cost than at any time in its history. Recent restructuring activities have resulted in operation cost reductions of



over 30 percent since 1992, due primarily to increasing efficiencies, streamlining the workforce, and reducing requirements. Reliability continues to improve. As of the end of FY 1998, the Space Shuttle had recorded 90 successful launches in 18 years. Consolidation of Space Shuttle contracts into a single prime contract was progressing with the incorporation of the Solid Rocket Booster (SRB) production contract into the Shuttle Flight Operations Contract (SFOC) during FY 1998.

Contributing to the ability of the SFOC contractor, United Space Alliance, to achieve program goals with a reduced workforce are the implementation of improvements and efficiencies to the Space Shuttle through its upgrades program. The phase 1 upgrades, i.e., upgrades that are primarily designed to improve Space Shuttle safety and performance, neared completion in FY 1998 with the first launch of the Super Lightweight Tank (SLWT) and scheduled final testing of the Block II Space Shuttle Main Engine (SSME) in preparation for its first flight in FY 1999. See "Rollout of the First Super Light Weight Shuttle Fuel Tank."

## Expendable Launch Vehicles

There were 29 successful U.S. Expendable Launch Vehicle (ELV) launches in FY 1998. Of those, three were NASA-managed missions, and two were NASA-funded/FAA-licensed missions. There were two launch vehicle failures—a U.S. Air Force-managed Titan IV-A and a commercial-licensed Delta III. NASA collaborated with the USAF, Lockheed Martin Aero-nautics, and Boeing in the failure investigations, corrective action, and return to flight process.

## Space Communications

NASA's space and ground networks successfully supported all NASA flight missions and numerous commercial, foreign, and other Government Agency missions. Mission Control and Data Systems provided operations of 15 on-orbit science missions. NASA awarded a consolidated space operations contract to outsource NASA's space operations under a single contract. The contractor, Lockheed Martin, will manage all of NASA's data collection, teleme-

try, and communications operations supporting NASA's Earth-orbiting satellites, planetary exploration, and human space flight activities.

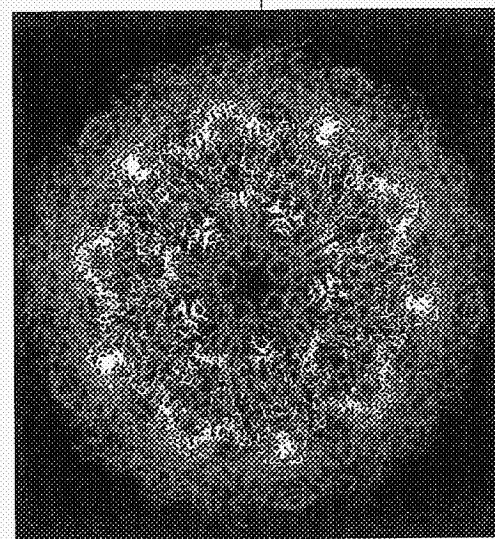
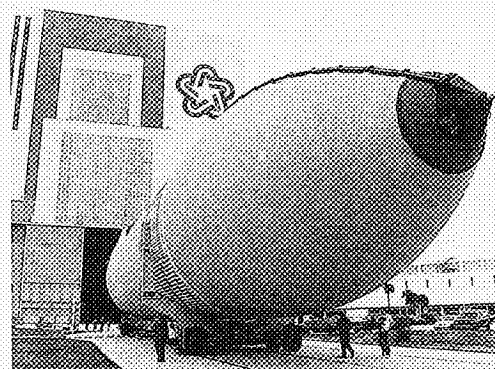
## Life and Microgravity Research

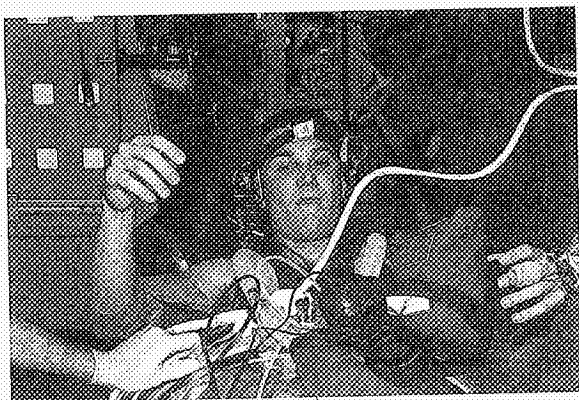
Findings in the Life and Microgravity Sciences range from fundamental information on human physiology to basic results in combustion science. For example, Dr. Kenneth Baldwin has published research which has clarified the role of nerve connections and the thyroid gland in the development of muscle. Dr. Gerald Faeth's research in combustion science suggests the existence of a "soot paradigm" which may supply improved methods for controlling soot processes in applications such as aircraft propulsion systems, diesel engines, and furnaces. Dr. Alex MacPherson established a new benchmark in the study of viruses by publishing a structure of the satellite tobacco mosaic virus at far greater resolution (1.8 Angstrom) than has ever been published before. Based on similar types of data, BioCryst Pharmaceuticals, Inc., and Johnson & Johnson agreed to collaborate on the development of a drug to treat influenza. See "Structure of Satellite Tobacco Mosaic Virus."

The premier mission of FY 1998 for the Office of Life and Microgravity Science (OLMSA) was the flight of the Neurolab Spacelab mission aboard the Space Shuttle. Research addressed both basic neuroscience questions and applied studies related to the astronauts' responses to space flight. It has importance for both the understanding and treatment of adverse effects of space flight on crew members and for the understanding and treat-

Top:  
Rollout of the  
First Super Light  
Weight Shuttle  
Fuel Tank

Bottom:  
Structure of Satellite  
Tobacco Mosaic Virus





Top:  
James A. Pawelczyk,  
Neurolab payload  
specialist, conducting  
experiments to deter-  
mine how the human  
nervous system  
adapts to the weight-  
lessness of space.

Right:  
Life Support Test  
Chamber

czyk, Neurolab payload specialist, conducting experiments to determine how the human nervous system adapts to the weightlessness of space."

Also flown in FY 1998 was the fourth U.S. Microgravity Payload mission (U.S.MP-4). OLSA researchers used the mission to conduct a series of experiments in physics and materials science. Initial results included observation of new physical behavior when matter is confined to only two dimensions during the Confined Helium Experiment (CHeX). The mission also allowed researchers to measure the growth speed and crystal size of a material that serves as a model for industrially useful metals.

The Phase 1 NASA/Mir Research Program included seven biomedical experiments in FY 1998 to evaluate the effects of space flight on sleep patterns; vestibular and immune functions; the risk of developing kidney stones; changes in bone mineral density, muscle mass and strength, and cardiovascular system function; and interactions between crew members and ground support.

Technology developed to support Life and Microgravity Sciences included a telemedicine Instrumentation Pack, flight tested in FY 1998, which may find applications in delivering health care through telecommunications here on Earth. Life support technology was tested through a 91-day closed chamber test with a crew of four. The primary objective of this test was to demonstrate the use of a combined physicochemical and biological life support system to support four human test subjects. Potable water, which easily met NASA's strict potability standards, was produced throughout

the test using a biological waste processor as the primary treatment step. See "Life Support Test Chamber."

## Space Operations

In October 1998, in a major step to streamline operations, NASA awarded a \$3.44 billion contract to manage the Agency's space operations activities. The Consolidated Space Operations Contract (CSOC) covers all of NASA's data collection, telemetry, and communication operations supporting its Earth-orbiting satellites, planetary exploration, and human space flight activities. The contract consolidates management responsibility from five NASA Centers to a single entity, an unprecedented step for a change of this magnitude. This contract is expected to save taxpayers approximately \$1.4 billion over 10 years.

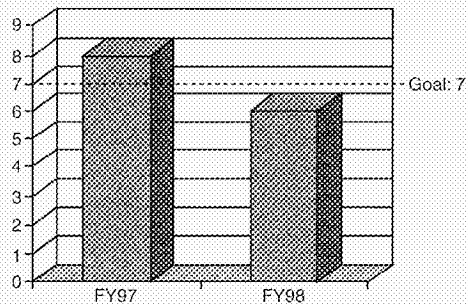
## Space Shuttle Safety, Reliability, and Efficiency Performance Measures

Improving Space Shuttle safety and reliability are indicated by a reduced rate of in-flight anomalies, increased on-time success for launches, and reduced time required for mission preparation. The goal of this performance measure is to sustain Space Shuttle operations by safely flying the manifest (scheduled missions) and aggressively pursuing a systems upgrade program that will reduce payload-to-orbit costs. This Enterprise objective directly supports the Agency goal of improving Space Shuttle efficiency, while achieving mission goals and transitioning to private-sector operations as appropriate. Specifically, the HEDS Enterprise seeks to achieve the following goals for 1999:

- seven or fewer flight anomalies per mission (see graphic "In-Flight Anomalies per Flight");



In-Flight Anomalies per Flight



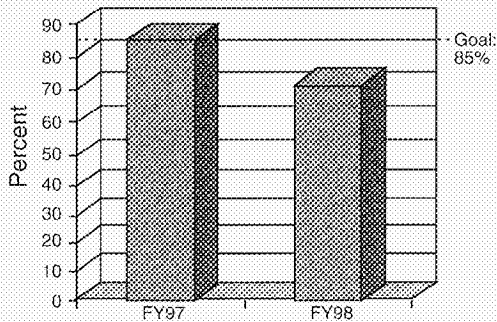
❑ achieve 85 percent on-time, successful launches (excluding the risk of weather) (see graphic "On-Time Success Rate"); and

❑ reduce manifest preparation to 14 months (see graphic "Space Shuttle Manifesting and Cargo Integration Time").

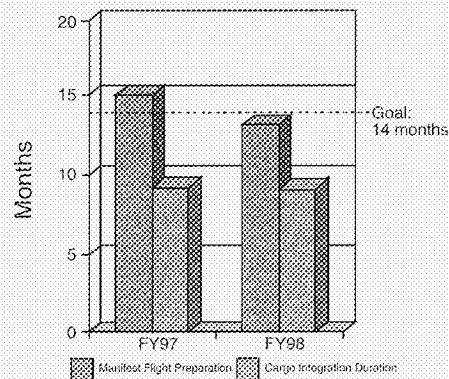
#### International Space Station Development Performance Measures

Development of the International Space Station is monitored through key milestones. The near-term objectives for this performance measure are to expand permanent human

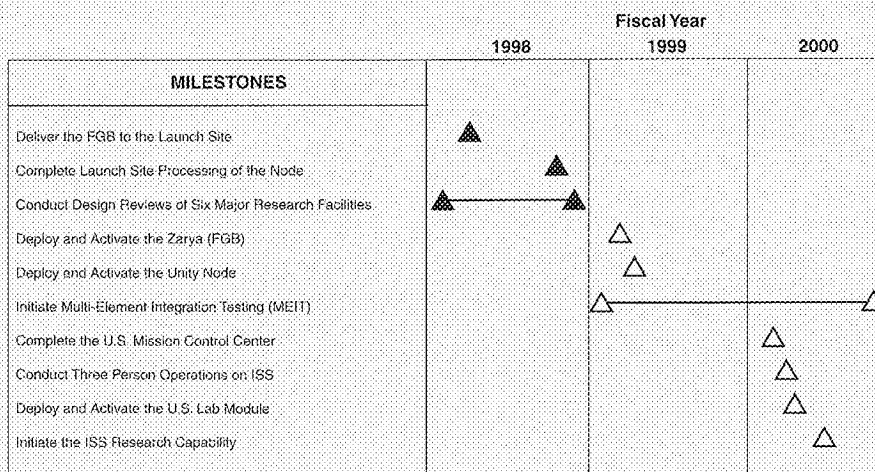
On-Time Success Rate



Space Shuttle Manifesting and Cargo Integration Time



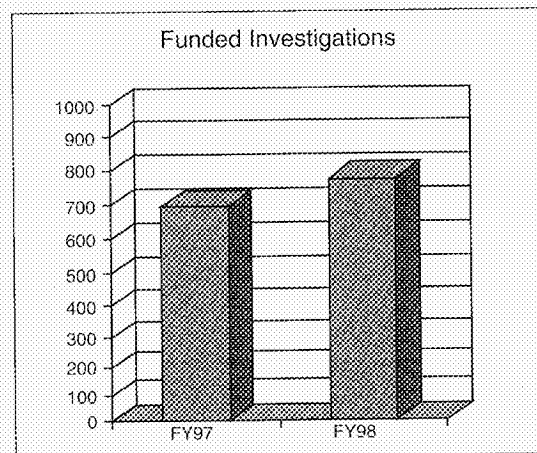
International Space Station Key Development Milestones



presence in low-Earth orbit by transitioning from Mir to the International Space Station program in order to enhance and maximize science, technology, and commercial objectives. This Enterprise objective directly supports the Agency goal to advance human exploration of space: assemble and conduct research on the International Space Station. See graphic "International Space Station Key Development Milestones."

#### Scientific Investigations Funded Performance Measure

HEDS is actively developing a community of researchers to explore fully the role of gravity in physical, chemical, and biological processes and to maximize the scientific return from HEDS assets. The near-term objective is to expand scientific knowledge by exploring the role of gravity and the space environment in



physical, chemical, and biological processes through a vigorous peer-reviewed research program in space. This Enterprise objective directly supports the Agency's goal to "explore the role of gravity and the space environment in physical, chemical, and biological processes." See graphic "Funded Investigations."

# Aero-Space Technology

## Mission and Questions

Research and technology play a vital role in ensuring the safety, environmental compatibility, and productivity of the air transportation system and in enhancing the economic health and national security of the Nation. Numerous factors, however, including growth in air traffic, increasingly demanding international environmental standards, an aging aircraft fleet, aggressive foreign competition, and launch costs that impede affordable access and utilization of space, represent formidable challenges to the Nation.

The mission of this Enterprise is to pioneer the identification, development, verification, transfer, application, and commercialization of high-payoff aero-space technologies. Through its research and technology accomplishments, it promotes economic growth and national security through a safe, efficient national aviation system and affordable, reliable space transportation. The plans and goals of this Enterprise directly support national policy in Aero-Space, documented in "Goals for a National Partnership in Aeronautics Research and Technology" and "National Space Transportation Policy."

This Enterprise works in alliance with its aero-space customers, including the U.S. industry, the university community, the Department of Defense (DoD), the Federal Aviation Administration (FAA), and the other NASA Enterprises, to ensure that national investments in aero-space technology are effectively defined and coordinated and that NASA's technology products and services add value, are timely, and have been developed to the level at which the customer can confidently make decisions regarding the application of those technologies.

The Enterprise also has Agency responsibility for technology transfer and commercialization. This function is provided as an Agency-wide service to ensure wide, rapid transfer of NASA-developed technologies to the U.S. industry for the social and economic benefit of all U.S. citizens.

The Enterprise addresses the following question:

- ❑ How do we enable revolutionary technological advances that provide air and space travel for anyone, anytime, anywhere more safely, more affordably, and with less impact on the environment and improve business opportunities and global security?

## Goals and Objectives

The Enterprise has three goals (pillars) supported by 10 enabling technology objectives. In addition, the Enterprise has a Research and Development (R&D) service goal.

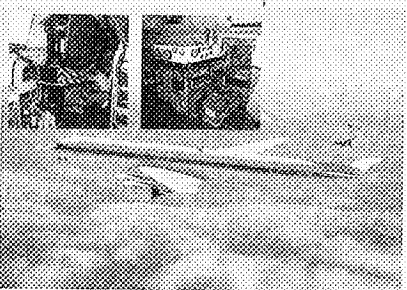
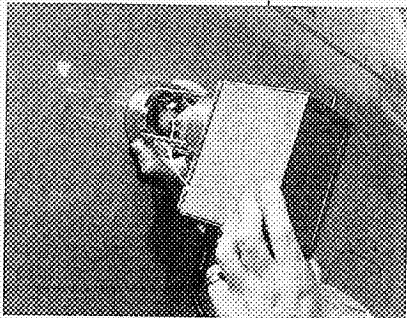
**Pillar One:** Global Civil Aviation will enable U.S. leadership in global civil aviation through safer, cleaner, quieter, and more affordable air travel. Pillar One is supported by five enabling technology objectives which address challenges in aviation safety, emissions reduction, noise reduction, aviation system capacity, and affordable air travel.

**Pillar Two:** Revolutionary Technology Leaps will revolutionize air travel and the way in which aircraft are designed, built, and operated. Pillar Two is supported by three enabling technology objectives which address challenges in high speed travel, general aviation, and design tools and experimental planes.

**Pillar Three:** Access to Space will enable the full commercial potential of space and the expansion of space research and exploration. Pillar Three is supported by two enabling technology objectives which address challenges in low-cost space access and in-space transportation.

**The Research and Development (R&D) Service Goal** will enable and, as appropriate, provide, on a national basis, world-class aero-space R&D services, including facilities and expertise, and proactively transfer cutting-edge technologies in support of industry and U.S. Government R&D.

A more detailed description of the Enterprise is available on the worldwide web at <http://www.hq.nasa.gov/office/aero/>.



## Accomplishments and Performance measures

The Enterprise produced many exciting accomplishments in support of its goals and objectives in FY 1998. These accomplishments will directly benefit the American people through safer, more affordable, and more environmentally-friendly air travel and more efficient and affordable access to space. A few of our accomplishments, organized by our goals and objectives, are highlighted here.

### Pillar One: Global Civil Aviation

*Aviation Safety: Reduce the aircraft accident rate by a factor of five within 10 years, and by a factor of 10 within 25 years.*

**Aging Aircraft:** The Aging Aircraft program was concluded in FY 1998 with the development of specialized engineering analysis tools and the transfer of all technology to the instrument manufacturing industrial community. This program developed structural integrity prediction methods that are now in use by all U.S. commercial transport airframe manufacturers. Non-destructive evaluation instruments (Figure 1) include the low-cost eddy current crack detector for fast detection of surface cracks, the rotating self-nulling probe for detecting cracks under rivet heads, and the thermal-line scanner for corrosion detection. An engineering handbook describing the methodology, and including the computer codes and experimental data, is available on the web (<http://irwin.larc.nasa.gov/handbook/index.html>).

*Emissions Reduction: Reduce emissions of future aircraft by a factor of three within 10 years, and by a factor of five within 25 years.*

**Environmental Assessment:** To predict the impact of the future fleet of subsonic aircraft, researchers must first determine the impact today's aviation is having on the atmosphere. The Subsonic Assessment Ozone and Nitrogen Experiment (SONEX) field campaign conducted in 1998 with the NASA DC-8 flying labora-

tory (Figure 2), was the first attempt to measure subsonic aircraft emission signatures in the North Atlantic Flight Corridor. SONEX successfully measured a significant Nitrogen Oxide (NOx) and particulate aircraft fingerprint within these flight corridors. This data will be a major contributor to the 1999 Intergovernmental Panel on Climate Change (IPCC) Special Report on Aviation and the Global Atmosphere and the basis for improving atmospheric models further.

*Noise Reduction: Reduce the perceived noise levels of future aircraft by a factor of two from today's subsonic aircraft within 10 years, and by a factor of four within 25 years.*

While the primary source of noise from today's airplanes is from jet engines, noise from the airframe, particularly during approach, also contributes to the overall noise impact. During landing, noise from the aircraft's flaps, slats, and landing gear nearly matches the level of engine noise. In future airplanes, airframe noise will be equal to engine noise not only during landing but also

Top Left:  
Crack Detection  
Instrument (Figure 1A)

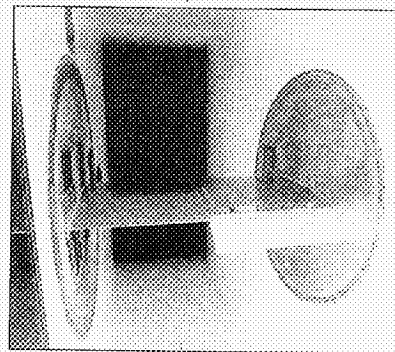
Middle Left:  
Crack Detection  
Instrument (Figure 1B)

Bottom Left:  
DC-8 Flying Laboratory  
(Figure 2)

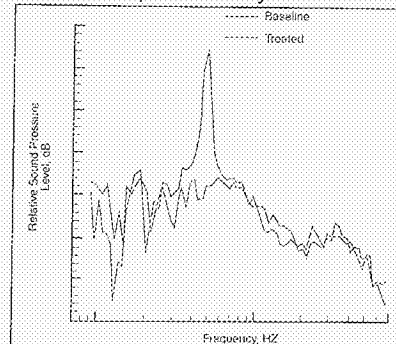
Bottom Right:  
Reduced Flap-Noise Test  
(Figure 3)

Baseline Model in Low  
Turbulence Pressure Tunnel

M= 2, Pn=7.2 M



Microphone Array Result



Left:  
Dallas-Fort Worth  
Airport Air Traffic  
Management  
(Figure 4)

Right:  
Advanced Disk  
Alloy Processing  
(Figure 5A)

during take-off. Airframe noise, like engine noise, can be controlled and reduced with advanced noise reduction technology. Recently, technology has been demonstrated to reduce flap noise, one of the three main airframe noise sources, by 60 percent. This was accomplished by NASA researchers in partnership with industry, academia, and the FAA. Results of a series of wind tunnel experiments, guided by newly developed noise and flow prediction models, successfully demonstrated significant noise reductions. Work continues in the program to reduce slat and gear noise, the other main airframe noise sources.

This accomplishment involved several NASA and industry wind tunnels, each one for its unique performance capabilities. The results, illustrated in Figure 3, are from a test performed in the Low Turbulence Pressure Tunnel. A microphone array was employed in this hard-walled facility to measure and localize the sound coming from the high-lift wing model shown. This wind tunnel ran at pressures greater than normal atmospheric conditions to more closely simulate full-scale flight conditions or Reynolds number. Advanced aerodynamic flow models were used to optimize noise reduction concepts for three different dominant airframe noise sources discovered for this wing model.

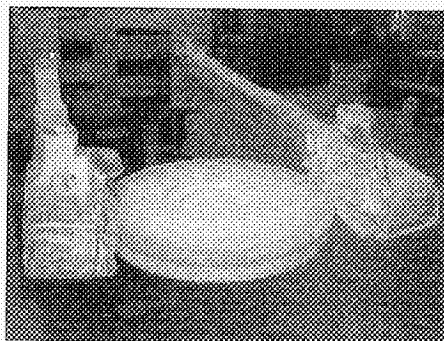
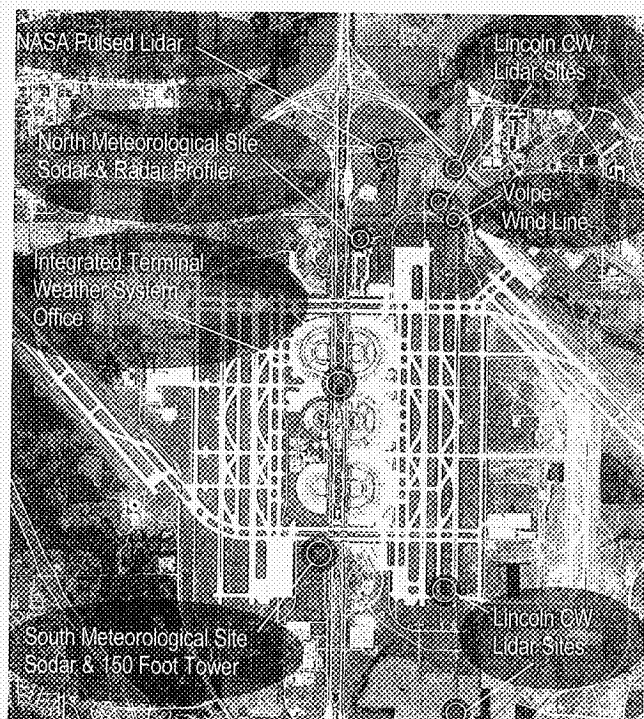
*Aviation System Capacity: While maintaining safety, triple the aviation system throughput, in all weather conditions, within 10 years.*

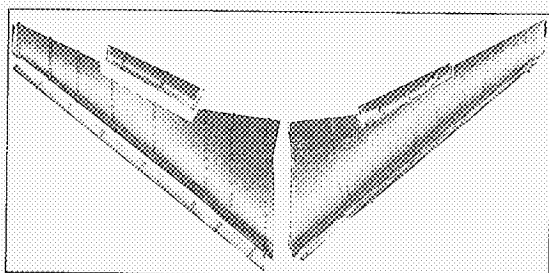
**Terminal Area Productivity:** All Aircraft Vortex Spacing System (AVOSS) subsystems have been proven in initial deployment at Dallas Fort Worth Airport (Figure 4). AVOSS is a technology that provides dynamic aircraft wake vortex spacing criteria with required lead time and stability for use in establishing aircraft arrival scheduling. Early results indicate significant capacity gains are possible should AVOSS be implemented. Spacing reductions of up to one mile between certain pairs of aircraft may be achievable under frequently occurring weather conditions. Work continues on refining the AVOSS predictor algorithms.

*Affordable Air Travel: Reduce the cost of air travel by 25 percent within 10 years, and by 50 percent within 25 years.*

**Engine Systems:** Optimized manufacturing technologies for advanced disk alloys (Figure 5A) have been demonstrated by a NASA/industry team. Application of these advanced disk prototype manufacturing processes and the advanced disk alloys will reduce engine pro-

duction and operating costs by extending disk life (by a factor of two) and maintenance intervals at current compressor exit temperatures, or allow future, more fuel efficient engines with higher compressor exit temperatures to contribute to attaining emission reduction goals. Materials processing technologies were demonstrated for advanced nickel-based disk alloys. A full-scale disk was produced from an advanced alloy using optimized produc-





Top Left:  
Pressure-Sensitive  
Paint Results  
(Figure 5B)

Top Right:  
Large Scale Model  
Engine Test (Figure  
6A)

Bottom Right:  
HSCT Materials  
(Figure 6B)

tion techniques, and manufacturing costs were compared to current generation disk alloys. Tensile, creep, and crack growth resistance properties were measured to demonstrate increased temperature capability and improved life.

**Airframe Methods:** Current aircraft design and development processes involve a series of independent, time-consuming steps. For example, the wing of an aircraft is designed and optimized for the cruise point, and then components such as the propulsion system are integrated into the design. The Airframe Methods project is working to reduce the design cycle time by delivering integrated design methodologies and new aerodynamic concepts. These concepts and tools will enable revolutionary aircraft designs and faster design cycles while reducing aircraft operating costs, environmental impacts, and aircraft development risks. Validated mid-term progress demonstrated a one percent improvement in aircraft operating cost and a 15 percent improvement in design cycle time. The project will be evaluated and realigned to ensure technologies developed will result in the stated goals of two percent reduction in aircraft operating cost and 20 percent reduction in design cycle time. The assessment was completed through system studies for baseline with Airframe Methods technology and design process advances. Of particular significance are the benefits from a pressure-sensitive paint (Figure 5B) system for use in wind tunnel research and improved methods for designing a cruise wing configuration. The pressure data compared very well to data obtained from a solution using computational fluid dynamics.

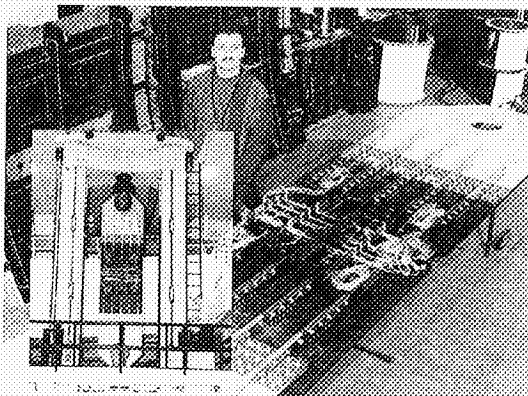
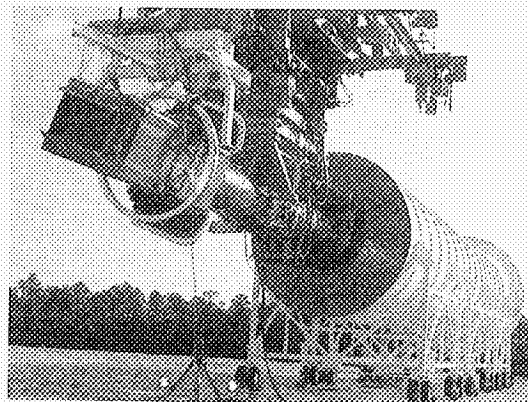
**Physics and Process Modeling:** Integrated design and process technologies for forged components capable of 50 percent reduction in development time and cost were validated. Connected design and process tools for forged disks were used to predict heat transfer, residual stress, and distortion in a quenched and machined disk. Comparison of distortion of experimental machined disks validated the use of the integrated tools.

## Pillar Two: Revolutionary Technology Leaps

*High Speed Travel: Reduce the travel time to the Far East and Europe by 50 percent within 25 years, and do so at today's subsonic ticket prices.*

Significant progress has been made on several fronts to develop technologies to establish the viability of an economical and environmentally sound High Speed Civil Transport (HSCT). This vehicle—if built by U.S. industry—could provide U.S. leadership in the long-range commercial air travel markets of the next century, offering returns of \$200 billion in sales and 140,000 high-quality jobs for U.S. workers.

**Propulsion:** Emphasis in this area is on selected individual subscale component and materials technology development efforts required for subsequent industry design of a HSCT engine. The technical challenge is to develop a propulsion system that is environmentally compatible in terms of meeting low emissions and noise requirements and economically viable in terms of performance and durability. Progress in HSCT propulsion includes



Bottom Left:  
HSCT Flight Deck  
(Figure 6C)

Bottom Right:  
TU-144LL Flying  
Testbed (Figure 6D)

completion of the first Large Scale Model 1 Engine Test (Figure 6A). The test established a level of acoustic suppression (predicted within 1.2 decibels of perceived noise levels) and aerodynamic performance (within 0.27 percent) simultaneously. A combustor design, a lean pre-mixed prevaporized concept, was selected based on demonstrations that emission of oxides of nitrogen were better than the program goal (5gm NOx/kg fuel) as well as supporting tests and analyses regarding performance (operability, cost to produce, and failure modes and effects analyses). A turbine airfoil alloy was selected for further development based on the results of mechanical and environmental tests, the alloy's compatibility with candidate bond coat/thermal barrier systems, and its demonstrated ability to be manufactured by casting while incorporating potential advanced cooling schemes into its design.

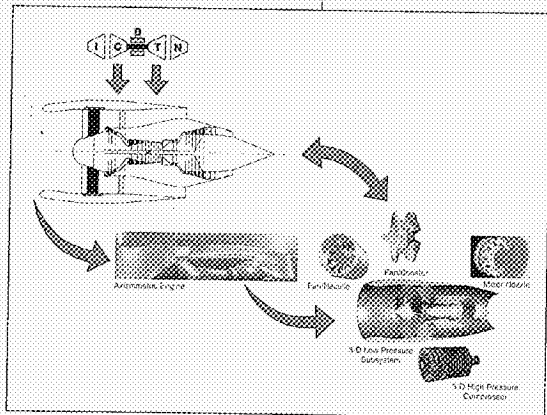
**Airframe:** Technology development in the areas of aerodynamics, materials and structures, and flight deck systems, required for subsequent industry design of a viable HSCT airframe, is progressing. Wing and fuselage subcomponent materials and structural concepts (Figure 6B) were selected for a HSCT. A Polymeric Matrix Composite (PMC) honeycomb sandwich with a titanium core was selected for

the wing and a PMC skin stringer for the fuselage. Aerodynamic optimization methods applied to three aircraft designs showed drag count improvements of three to six. Potential flight deck concepts (Figure 6C) in flight path management, display design, control inceptor, and decision aiding were installed and initial evaluations conducted. The medium throw center stick was selected over yoke/column and side stick based on pilot evaluations of aircraft handling, pilot control panel accessibility, and systems integration (weight, volume, power). Rollout ceremonies were held for the Surface Operations Research Vehicle, a full-scale, ground-testing vehicle being used to address the unique research issues associated with the taxi operations of a HSCT.

**TU-144LL Russian Aircraft:** In a partnership among NASA, Boeing, and Tupolev, a flight test program involving the TU-144LL (Figure 6D) accomplished several objectives. Eighteen research flights were completed involving six flight experiments that studied aerodynamics, thermodynamics, structural and cabin noise, propulsion systems environment, aircraft handling qualities, and landing characteristics. These flight experiments will allow researchers to compare full-scale supersonic aircraft flight data with results from models in wind tunnels, computer-aided techniques, and other flight tests. Further flight research activities using the TU-144LL Flying Laboratory are planned.

*General Aviation: Invigorate the general aviation industry, delivering 10,000 aircraft annually within 10 years, and 20,000 aircraft annually within 25 years.*





Top Left:  
General Aviation  
Advanced Cockpit  
(Figure 7)

Bottom Left:  
Numerical  
Propulsion System  
Simulation (Figure 8)

Top Right:  
X-33 Liquid  
Oxygen (LOX) Tank  
(Figure 9A)

Bottom Right:  
X-33 Design Features  
(figure 9B)

The general aviation community, which includes over 135,000 privately owned aircraft, has tremendous potential for growth with the resolution of several technical issues. At its peak in 1978, the U.S. general aviation industry delivered 14,398 aircraft. In 1994, the number of aircraft had fallen to 444, an all-time low. The Advanced General Aviation Transport Experiments (AGATE) Consortium was initiated by NASA, in cooperation with the U.S. aviation industry,

academia, and the FAA, to create the technological basis for this revitalization. The technology innovations being developed by AGATE for general aviation will revolutionize and revitalize this industry. These technologies include a modular systems avionics architecture that was downselected from three candidates to one. A prototype flat panel display system based on this architecture was installed in the AGATE 1B demonstrator aircraft that was displayed at Oshkosh, Wisconsin, this year (Figure 7). The electronic display allows the pilot to focus on critical information, rather than on reducing data in order to make decisions, thus improving safety, reliability, and ease of use.

*Design Tools and Experimental Planes: Provide next-generation design tools and experimental aircraft to increase design confidence, and cut the development cycle time for aircraft in half.*

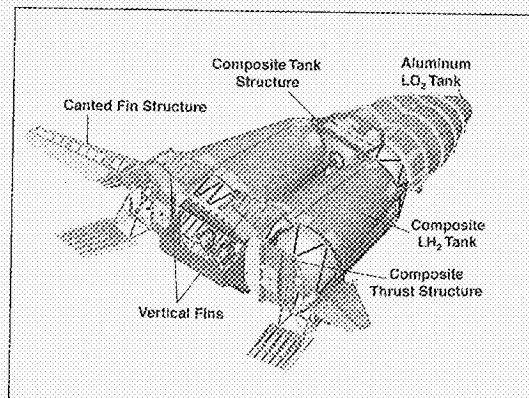
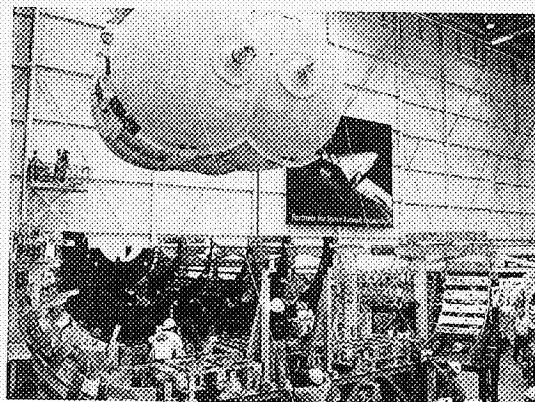
**Computational Aerosciences (CAS):** A portable, scalable programming and runtime environment for Grand Challenge applications on a TeraFLOPS scalable system (Numerical Propulsion System Simulation/National Cycle Program Version 1) (Figure 8) was demonstrated and delivered to industry partners in August 1998. The evaluation of automated legacy-code parallelization tools, job management systems, and Distributed Computing Environment was completed. Parallel system monitoring and debugging tools as well as distributed system management tools were also developed.

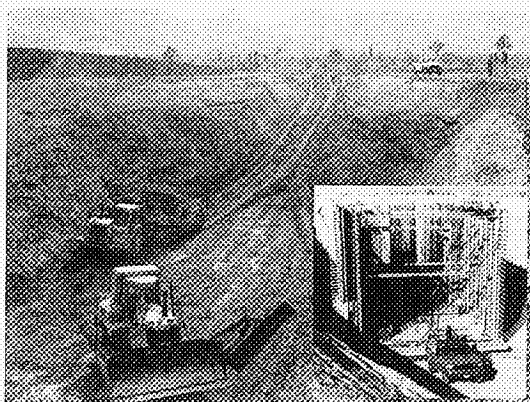
## Pillar Three: Access to Space

*Low-Cost Space Access: Reduce the payload cost to low-Earth orbit by an order of magnitude, from \$10,000 to \$1,000 per pound, within 10 years, and by an additional order of magnitude within 25 years.*

**Liquid Oxygen (LOX) Tank:** In April 1998, the X-33's first major flight component, the liquid oxygen tank (Figure 9A), was placed in the vehicle's assembly structure in Palmdale, California, by Lockheed Martin Michoud Space Systems. Its integration marks the start of an aggressive schedule that calls for the X-33 vehicle roll out in early 2000, with flight tests to begin in the summer.

**X-33 Critical Design Review:** The X-33 Critical Design Review (Figure 9B) was successfully completed in October 1997. Approximately 600 representatives from NASA, industry team lead Lockheed Martin, industry partners, and the U.S. Air Force participated in the 5-day review held at Edwards Air Force Base, California. The review gave the program a





vote of confidence and the go-ahead for the fabrication of all remaining components and the completion of subsystems and assembly of the vehicle. The review also served as an opportunity for program officials to announce the resolution of issues that arose earlier that year regarding vehicle weight and aerodynamic stability and control.

**Launch Site Construction:** The completion of the Environmental Impact Statement paved the way for construction to begin in November 1997 on the X-33's launch site (Figure 9C) at Edwards Air Force Base. Approximately 100 workers constructed the \$30 million launch facility, completed in 1998 with checkout now underway.

*In-Space Transportation: Reduce the payload cost of interorbital transfer by an order of magnitude within 15 years, and reduce travel time for planetary missions by a factor of two within 15 years, and by an order of magnitude within 25 years.*

#### **NASA Solar Electric Propulsion Technology Applications Readiness (NSTAR):**

The primary propulsion system for NASA's first mission to be flown under the New Millennium Program, Deep Space 1, is an ion propulsion (or solar electric) engine (Figure 10). This type of engine, developed at the Lewis Research Center, generates thrust by accelerating electrically charged xenon atoms at speeds up to 68,000 miles per hour. The thrust of this engine is very low, equivalent to the pressure exerted by a sheet of paper held in the palm of a hand. The ion engine, how-

ever, can deliver 10 times as much thrust per pound of fuel as a liquid or solid fuel rocket, making it the most efficient engine ever flown. This increase in efficiency will lower the requirement for on-board propellant mass, which will enable future missions to be launched on smaller, lower-cost launch vehicles. The ion engine for the Deep Space 1 mission was developed under the NASA Solar Electric Propulsion Technology Applications Readiness (NSTAR) project. JPL and Lewis Research Center partnered on this project. The Deep Space 1 mission and New Millennium Program are managed by JPL.

During FY 1998, the ion engine completed all acceptance and qualification tests, was integrated with the power processing unit, and was installed on the Deep Space 1 spacecraft. Preparations were also made for mission profile testing of a flight spare ion engine on the ground. Deep Space 1 was launched on a Delta II rocket on October 24, 1998. This will be a two-year mission primarily focusing on technology validation, while performing an asteroid fly-by in July 1999.

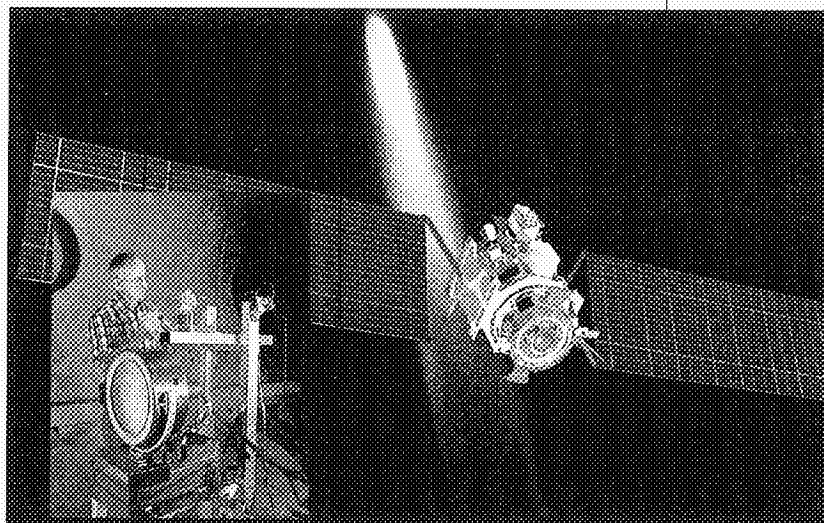
The Enterprise tracks program-wide performance measures for its performance commitments and its customers' satisfaction.

#### **Deliverables Completed as a Percentage of Planned Deliverables Performance Measure**

Each Enterprise program uses measurable customer-negotiated product and service deliver-

Top Left:  
X-33 Launch Site  
(Figure 9C)

Bottom Right:  
NSTAR Ion Propulsion  
(Figure 10)



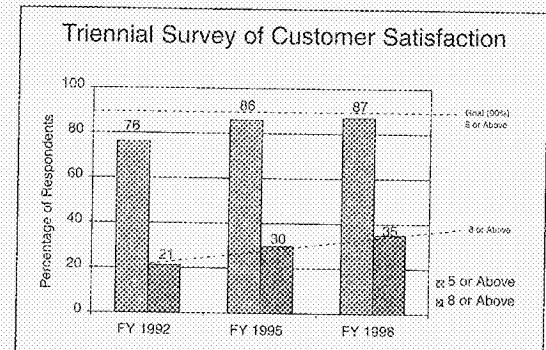
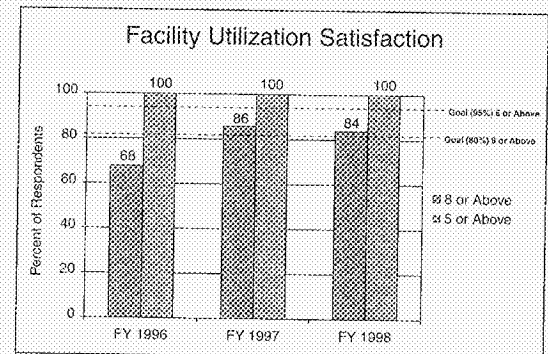
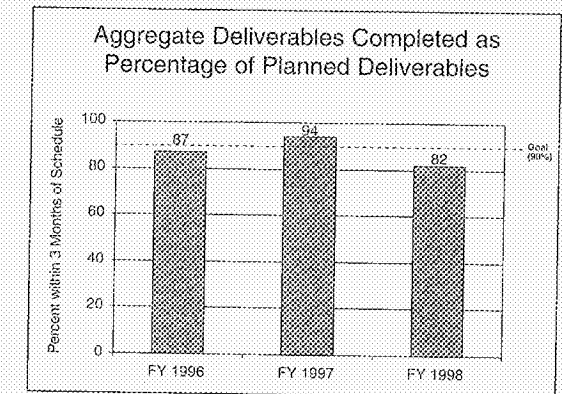
ables to track annual performance against plans, including specific success criteria for milestone completion assessment. This metric aggregates performance of all individual program milestones to provide a composite indicator of progress toward the 10 objectives of the Enterprise's three Technology goals. The Enterprise metric is to complete 90 percent of customer-negotiated product and service deliverables within three months of the established commitment date. The Enterprise completed 82 percent of its planned deliverables within the three-month metric; eight percent were completed four to six months late.

#### Satisfaction with Facility Use Performance Measure

One of the major services provided by the Enterprise to its customers is access to NASA's critical research and development facilities, such as wind tunnels. Each of the four NASA Research Centers (Ames, Dryden, Langley, and Lewis) conducts exit interviews at selected facilities. This metric aggregates the interview results to provide an overall indicator of customer satisfaction relative to the Enterprise Research and Development Services goal. Facility-by-facility data is available and used to improve customer satisfaction. The Enterprise metric is to have 95 percent of facility exit interview respondents rate satisfaction with aeronautics facilities at "5" or above (on a scale of 1 to 10) and to have 80 percent rate facilities at "8" or above. For FY 1998, the Enterprise exceeded both goals, scoring 100 percent and 84 percent, respectively.

#### Overall Customer Satisfaction Performance Measure

The Enterprise serves a range of customers, including the aviation and related industries, the academic community, non-aviation industries, and other Government Agencies (such as DoD and FAA). On a triennial basis, the Enterprise surveys its customers to get their input on a wide range of issues, including overall customer satisfaction. This measure provides direct feedback from users and partners on the level of satisfaction with NASA technol-



ogy activities supporting the 10 objectives of the Enterprise's three technology goals, and also with respect to the Research and Development Services Goal. The metric is to consistently improve the percentage of respondents which rate the Enterprise at "8" or above (on a scale of 1 to 10), with 90 percent rating the Enterprise at "5" or above. For 1998, based on the latest survey, the Enterprise improved on the "8" and above rating (from 30 to 35 percent), with the "5" and above rating approaching 90 percent.

# Crosscutting Management Activities

NASA manages its programs through four enterprises: the Earth Science Enterprise, the Space Science Enterprise, the Human Exploration and Development of Space Enterprise, and the Aero-Space Technology Enterprise. The work of these Enterprises is supported by four crosscutting management processes:

- ❑ Manage Strategically,
- ❑ Provide Aerospace Products and Capabilities,
- ❑ Generate Knowledge, and
- ❑ Communicate Knowledge.

## Manage Strategically

The Manage Strategically process involves the planning, direction, and oversight of agency activities.

### Mission and Goals

The basic mission of this process is to provide policy, direction, and oversight to Enterprises, functional staff, and Centers to enable the accomplishment of programs. The goal of this process is to provide a basis for the Agency to carry out its responsibilities effectively and safely and enable management to make critical decisions regarding implementation activities and resource allocations, while ensuring consistency with the goals, objectives, and strategies contained in NASA's Strategic, Implementation, and Performance Plans.

Through strategic management, NASA measures its performance and communicates its results, demonstrating its relevance and contributions to national needs. This Accountability Report highlights accomplishments and performance measures in four strategic areas and in activities to comply with legal and regulatory requirements.

### Objectives

The objectives of the Manage Strategically process are to:

- ❑ align Agency direction and deployment decisions with external mandates and the

requirements of our customers, partners, and stakeholders;

- ❑ communicate Agency direction and decisions throughout the NASA Team and to the external community in a timely, consistent, and understandable manner;
- ❑ optimize Agency investment strategies and systems to align human, physical, and financial resources with customer requirements, while ensuring compliance with applicable statutes and regulations;
- ❑ improve the effectiveness and efficiency of Agency acquisitions through the increased use of techniques and management that enhance contractor innovation and performance;
- ❑ ensure that information technology provides an open and secure exchange of information, is consistent with Agency technical architectures and standards, demonstrates a projected return on investment, reduces risk, and directly contributes to mission success; and
- ❑ foster leadership that demonstrates a commitment to the Agency's values, principles, goals, and objectives.

### Accomplishments and Performance Measures

The accomplishments and performance measures for this process are summarized in several areas: Human Resources, Physical Resources, Equal Opportunity Programs, Procurement, Information Technology, and Financial Management.

### Human Resources

NASA has made significant progress in its movement toward a smaller, more focused, civil service workforce. More than 85 percent of the 7,500 full-time equivalent (FTE) reductions needed in its civil service workforce have already been accomplished through voluntary measures such as separation incentives, hiring freezes, attrition, and aggressive outplacement.

NASA began its restructuring efforts in 1993 when it had approximately 25,000 civil servants

at its Headquarters and Centers. By the year 2000, NASA plans to have fewer than 18,000 civil servants. This workforce size was determined following a comprehensive Zero Base Review that redefined roles and mission and program management structures consistent with outyear funding levels, but which maintained our staunch commitment to mission safety.

Reducing staff levels has been a carefully managed process with continuous monitoring and adjusting. The chart at the end of this section shows the progress already accomplished as well as the extent of the reductions yet to be made.

NASA has relied on several concurrent approaches for reducing staff and restructuring the organization:

**Restricted Hiring:** Beginning in FY 1993, some degree of hiring limitation has been in effect each year as hires have been held to a fraction of losses. Before filling a job from outside the hiring organization must search internally at other Centers to ensure that qualified individuals who could move to the vacancy have not been overlooked.

**Expanded Use of Non-permanent Appointments:** NASA has recently begun to use temporary and term appointments to acquire some new employees for non-continuing work, especially work of a short-term project nature. This will create a more flexible workforce where modest fluctuations in employment levels can be accomplished by separating non-permanent employees. Individuals taking such appointments are aware of the time-limited nature of their employment.

**Buyouts:** The staff reductions to date could not have been accomplished smoothly without these incentive payments. More than 4,500 employees left the Agency voluntarily during the first four buyouts. NASA's use of this program received praise from employees, managers, and unions and was recognized by both the Office of Personnel Management (OPM) and the Office of Management and Budget (OMB) as a model program. NASA developed a logical plan to ensure program integrity, fairness to employees, and assurance that NASA

could continue to perform its functions after employees separated. Separation incentives allowed the Agency to reduce overall workforce costs, maintain workforce diversity, and sustain continuity of operations with an appropriate blend of junior and senior employees.

**Early Retirement:** At NASA's request, OPM has granted early retirement authority for use by those organizations in NASA which have not achieved their reduced staffing goals. Used in conjunction with buyouts, early retirement authority has been extremely important to achieving voluntary staff reductions.

**Career Transition Assistance:** Initially implemented to assist employees contemplating taking a buyout, NASA's Career Transition Assistance Program has taken on an active role in encouraging all employees to look at the broad range of opportunities available outside of the Federal Government. NASA has also developed innovative trial and phased retirement programs, including a program that enables employees to begin a new career as a teacher.

**Organizational and Managerial Restructuring:** In the wake of past buyout losses and in order to align themselves with the NASA Strategic Plan, the Centers have reorganized. This has postured them to carry out their assigned Lead Center and Center of Excellence roles. The reorganizations have also enabled NASA to make significant progress on the Presidential Directive to improve supervisory ratios by a factor of two: a ratio of one supervisor to 11 non-supervisors. The ratio at this time is nearly 1:10.

The remaining reduction of 1,000 civil servants is concentrated at JSC, KSC, and MSFC, and therefore, will be a formidable objective, particularly since the Agency has made a commitment to its employees and Congress to exhaust all available voluntary measures before using involuntary mechanisms. NASA simply cannot allow attrition to take its natural course. That would lead inevitably to reduction in force actions at multiple Centers. Active, Agency level management is essential. We will continue to pursue a combination of strategies to meet the target staffing levels.

### Reduce Civil Service Employment Performance Measure

Reducing civil service employment aligns human resources levels with external mandates, helps optimize Agency investment strategies, aligns human resources with customer requirements, and sustains mission safety. NASA has reduced civil service employment below its targets every year since 1993. NASA is working toward continued reductions in 1999 and 2000. See chart "NASA FTE Civil Service Reduction Plan."

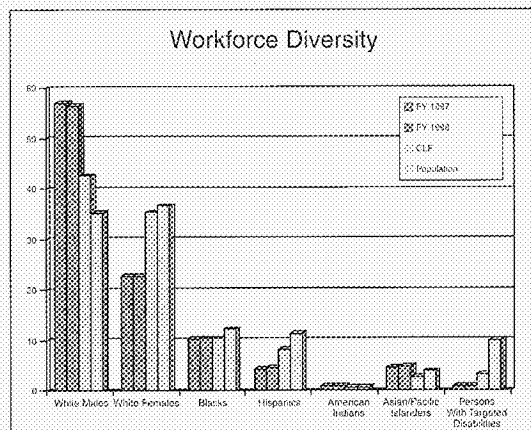
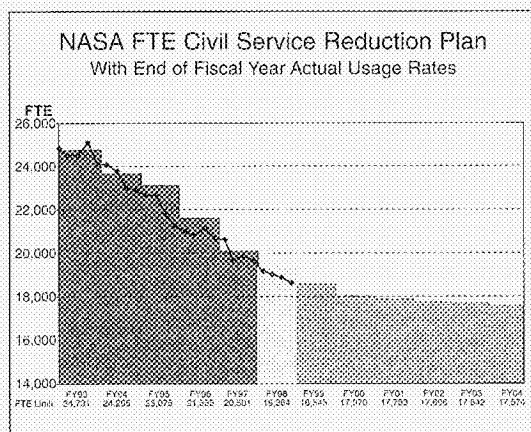
### Increase Workforce Diversity Performance Measure

NASA has made significant strides in diversifying its workforce at all levels. Additionally, NASA takes great pride in its astronaut corps, which reflects the face of America. NASA is increasing workforce diversity by working toward a long-term goal that reflects the diversity of America, and of the Civilian Labor Force (CLF). The effort aligns human resources with external mandates and increases alignment

with customer requirements. NASA has increased its workforce diversity over the last two years. See chart "Workforce Diversity."

### Physical Resources

NASA has made significant progress in optimizing Agency investment strategies to align physical resources with customer requirements. It has identified and integrated new techniques and technologies for the best use of past and future investments. Examples of these strategies include partnering, value engineering, performance-based contracting, energy conservation, recycling, pollution prevention, and outsourcing. In turn, this dramatically increases the return on investment of scarce resources. Good physical resource management supports NASA's vision and mission to further America's aerospace programs. Currently NASA is focusing its efforts in three areas to maximize the value of physical resources management to its programs.



**Functional Leadership:** Strong, Agency-wide functional leadership ensures NASA's mission success while optimizing effectiveness and efficiency, maintaining the appropriate balance between mission needs and functional performance standards. A fully consolidated and integrated Asset Management System will enable and support full-cost principles and facilitate implementation of performance based contracting. NASA will incorporate the following strategies and methods: lead centers, partnerships, and virtual and parallel teams; consolidation and standardization of functional processes; sharing of best practices across the Agency; and use of risk-based analysis, including business cases.

**Leveraging Resources:** New techniques and technologies for the best use of past and future investments will dramatically increase the return on investment of scarce resources. Crosscutting processes will ensure decisions result in the optimal use of constrained resources. Improvements in the knowledge and skills of our workforce will facilitate achievement of breakthrough results in functional management areas. This will be demonstrated and tracked in four different ways. The first is by achieving a five percent increase in physical

resource costs avoided from the previous year through alternative investment strategies. Cost avoidance is a result of an action that avoids a potential greater future cost. The metric does not reflect dollars saved but rather costs avoided through proactive, efficient, and effective management of NASA's physical resource responsibilities. The second is by reducing physical asset holdings, both real and personal property, by 25 percent from the FY 1997 baseline, by FY 2007. The third is by achieving a 50 percent reduction of toxic chemical releases and transfers by FY 2000 from the FY 1994 baseline. The fourth is by enhancing NASA's ability to acquire, maintain, and dispose of facilities and achieve a greater than 90 percent scheduled facility availability.

**Functional Assessment:** Enhancements to senior management decision making will result from providing Agency-wide functional assessment, stewardship, risk assessment, and insight into cross-functional performance. This will be accomplished in a variety of ways, including providing functional assessments to senior management and developing functional leadership initiatives to address identified issues and risks. Another methodology will be the alignment of functional policies with NASA's Strategic Management System and alignment of physical asset support with our customers' requirements. This will be measured by achieving a satisfaction survey score of 4.5 or greater, on a scale of 5, by FY 2005.

### Equal Opportunity Programs

Through its record of accomplishing Equal Opportunity, the Agency's space benefits are accessible to all Americans through a number of major programs.

**Equal Opportunity and Diversity:** NASA is a leader in providing equity and diversity in fields such as mathematics, science, and engineering that historically have low participation rates by women, minorities and individuals with disabilities.

**Multicultural Education:** NASA develops and deploys a variety of training curricula for

enhancing the ability of managers, supervisors, and employees to increase and manage diversity in the workplace.

### Complaints Processing, Adjudication, and Alternate Dispute Resolution (ADR):

NASA has an efficient discrimination complaints processing system to address allegations of discrimination made by employees or applicants for employment. All 10 NASA Centers also actively employ some form of Alternative Dispute Resolution (ADR) to respond to employee concerns at the lowest organizational level and at the earliest opportunity.

### Minority University Research and Education:

NASA is a leader in achieving the full participation of Minority Institutions in the mainstream-sponsored research and education community, striving for academic excellence and outstanding achievements while advancing America's leadership in a competitive global economy.

NASA Equal Opportunity accomplishments in FY 1998 have been significant. About 26 percent of senior managers reporting to the Administrator are women and/or minorities. The overall representation of women and minorities has increased from 39.5 percent to 43.4 percent since April 1992. Minorities employed by NASA increased from 16.5 percent to 20.6 percent since 1992. Women and minorities in the Senior Executive Service increased from 9.2 percent to 25.4 percent over the same period.

In FY 1996, NASA developed an automated complaint tracking system, which allows the Office of Equal Opportunity Programs (OEOP) to quickly and efficiently retrieve information on individual cases as well as generate statistical data and charts at the touch of a button. Efforts are currently underway to transform the system into a state of the art worldwide website application which will establish one central database of complaint information for the Agency, eliminate the need for Center purchasing of software packages or development of individual tracking systems, allow Centers to input and access all pertinent information on

their respective Center complaints, and respond to management needs for key information in a highly efficient manner.

In December 1997, the Equal Employment Opportunity Commission (EEOC) issued new enforcement guidance on the application of EEO laws to certain temporary or "contingent workers," and indicated that private sector as well as Federal sector employers could be held liable. As a result of this guidance, NASA has developed agency-wide procedures for addressing the complaints of contingent workers.

The EEOC has recently proposed changes to the Federal sector discrimination complaints process, which, once effected, will require extensive changes to NASA's complaints processing procedures. In anticipation of these changes, OEOP has begun to provide extensive guidance and assistance to the Centers in developing and revamping their ADR processes to ensure that they are in conformance with EEOC requirements and continue to meet the needs of the Centers.

During FY 1998, NASA OEOP invested \$51.4 million in 80 Minority Institutions to conduct 267 research and education projects. More than 575 faculty level and 1100 student researchers from Minority Institutions conducted research in all NASA-related Enterprise areas. Research accomplishments were published in more than 550 refereed papers or book chapters. During this period, principal investigators and students delivered over 1300 technical presentations.

Through 230 educational partnerships with Minority Institutions, school districts, and professional associations, NASA OEOP supported national efforts to enhance the participation and achievement of pre-college, undergraduate, and graduate students and teachers in NASA-related educational activities. More than 45,000 participants were reached through these efforts.

Since 1994, NASA's Multicultural Education Program has produced nearly 100 trained facilitators, and 10 Center-specific curricula with similar common themes, achieved high degrees

of satisfaction with over 85 percent of the over 10,000 employees trained Agency-wide, and generated numerous spin-off activities that continue to promote the value of a multicultural workforce in the Agency.

## Procurement

NASA has continued its activities to improve the efficiency and effectiveness of the procurement process and communications with industry. The Agency's procurement presence on the Internet is one of the largest in the Federal Government, and greater use of "shared" contracts to meet requirements remains a strong Agency initiative.

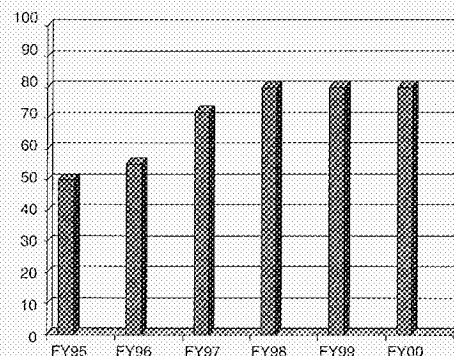
Communications with contractors are vital to improved performance. This is NASA's primary objective in emphasizing the importance of past performance as an evaluation factor. In FY 1998, the Agency began the systematic collection of past performance data for NASA contracts.

Performance-Based Contracting (PBC) requires structuring all aspects of an acquisition around the purpose of the work to be performed, as opposed to how it is to be performed or upon broad and imprecise statements of work. PBC emphasizes quantifiable, measurable performance requirements and quality standards in developing statements of work, selecting contractors, determining contract types, incentives, and performing contract administration, including surveillance. NASA has placed a high priority on applying PBC to its procurements. Senior NASA management strongly supports this effort. NASA conducted Agency-wide PBC awareness training to explain the initiative to both Government and contractor employees, and a training program was put in place for technical and procurement personnel. As a result of continuing management attention and specific training, PBC has transitioned from an "initiative" to standard practice.

## Performance-Based Contracting Performance Measure

This metric measures improved effectiveness and efficiency of Agency acquisitions through

NASA PBC Obligations as Percentage of Amounts Available for PBC



the increased use of techniques and management that enhance contractor innovation and performance. Performance-based contracting is an example of such techniques. In FY 1998, NASA obligated \$7.6 billion under 1532 PBC contracts, or 80 percent. In FY 1999, NASA expects to match this percentage. See chart "NASA PBC Obligations as Percentage of Amounts Available for PBC."

### Information Technology

NASA develops and operates a very complex information technology (IT) system capability, featuring over 36 major mission critical systems. Each year, NASA invests \$1.6 billion and 1,350 personnel in IT. NASA utilizes over 50,000 desktop computers, and moves nearly one million electronic mail messages daily. Modern, sophisticated IT is enabling NASA to deliver on its commitments for better, faster, cheaper, and safer missions and products.

Earlier this year, *Yahoo*, an internet utility, named NASA as having the number one website on the worldwide web. The incredible images and data that were returned from the Mars Pathfinder mission sparked the imagination and interest of the world. The Pathfinder web page was the most frequently accessed web page last year, with over 500 million hits recorded during July, 1998.

**Approach to Year 2000 (Y2K) Issues:** NASA continues to take aggressive actions to ensure

that our missions, systems, and supporting infrastructure and facilities are not disrupted. The NASA Administrator established an internal target for completing implementation of renovated systems by February 1999. NASA plans to implement all but two mission critical systems by the target date; the others will be implemented by March 1999. Resources necessary to make NASA systems Y2K compliant are \$46.7 million from FY 1996 to FY 2000. The risks to the Agency include failure of a mission-critical system which may result from failure introduced by Y2K failures of others (e.g. contractors delivering IT products and services, international business partners, infrastructure service providers). NASA programs and projects will ensure that Y2K operational readiness is validated and certified through end-to-end testing or high fidelity simulation. We are continuing to aggressively work with our international partners to resolve any potential Y2K impacts. We are aggressively working with our contractors and business partners to ensure our suppliers are prepared for Y2K. With regard to contingency planning, in September 1998, each NASA Enterprise and Center formulated its strategy and approach for business continuity planning. We will complete detailed plans that address NASA missions, programs, and core business functions by March 1999. As part of the overall planning effort, we have already addressed contingencies for many flight programs, high-risk systems, and programs involving international partners.

NASA is reducing the cost of IT support while providing improved and innovative support capabilities. NASA's innovations in IT support for various NASA projects are highlighted by the IT best practices and successes summarized below.

**Air Traffic Control:** NASA, with the Federal Aviation Administration, has developed an automated traffic control system which assists air traffic controllers in managing and controlling traffic near major airports and in reducing delays and increasing airport capacity, without increasing controller workload.

**Education:** The Telescopes in Education Outreach Project brings live astronomy into classrooms around the world. With this system, students in kindergarten through twelfth

grade can conduct astronomy research using remotely controlled telescopes and cameras in a real-time, hands-on interactive environment from classroom computers.

**Remote Sensing and Control:** An instrument control language is being developed based on a World Wide Web Consortium standard called Extensible Markup Language. The software architecture is designed to provide remote control of spacecraft instruments.

**Project Management:** The Virtual Information Management System links all of NASA's propulsion test facilities together and matches propulsion testing requirements with available testing capabilities. Use of this system has produced a total cost savings/avoidance of \$24 million.

**Security:** IT security awareness is being strengthened at NASA. Employees are being made aware of security threats and of their responsibilities in protecting sensitive data. Furthermore, the Agency's network computer security posture is undergoing improvements through the use of various commercial off-the-shelf software products, firewalls, user authentication tokens, and various monitoring devices designed to control and monitor access to IT resources.

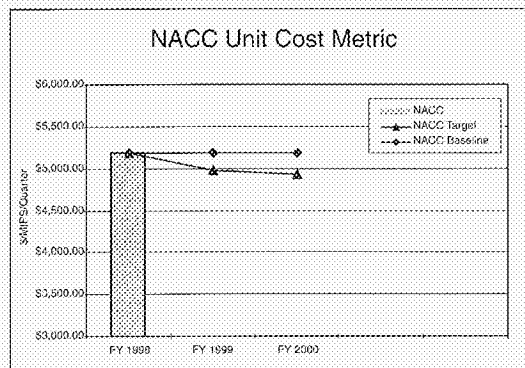
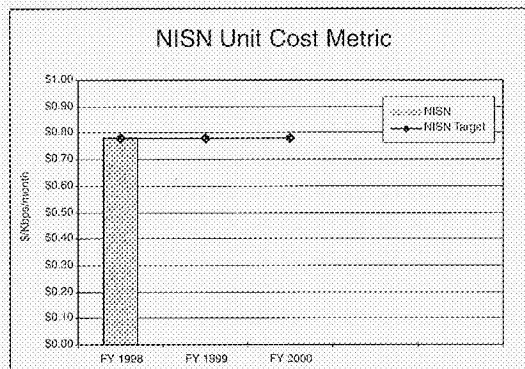
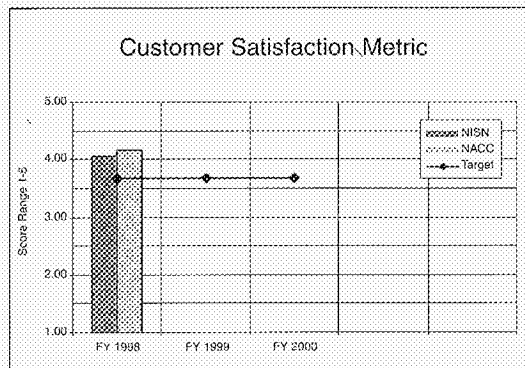
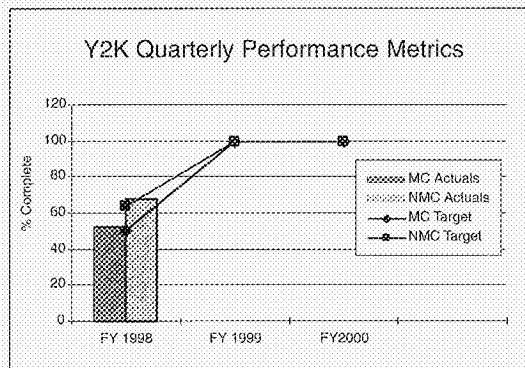
**Personnel Management:** A web-based Goal Performance Evaluation System, which links employee performance to agency and Center strategic plans, has been developed by NASA. This system, being implemented at four NASA Centers, is helping to make the employee performance evaluation system more mission oriented.

**Document Management:** NASA has developed a comprehensive, web-based set of document management systems to collect and disseminate Agency information both internally and to the public.

#### Improving IT Capability and Services Performance Measures

NASA has established an Agency-wide IT performance objective of improving IT capability and services, and evaluates its accomplishment through performance measurements of the

NASA ADP Consolidation Center (NACC) and the NASA Integrated Services Network (NISN). Performance is baselined at FY 1998



levels and tracked against targets on a quarterly basis. Under this objective, the following targets have been established:

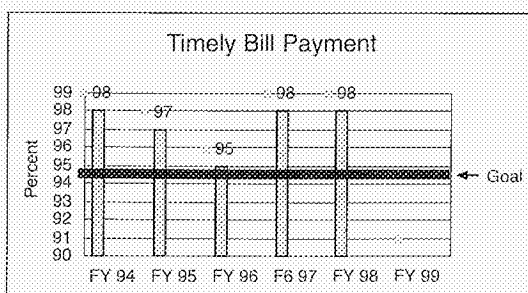
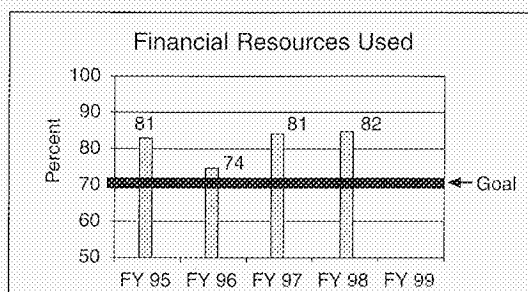
- ❑ complete Year 2000 remediation of mission critical (MC) systems by March 1999 and non-mission critical (NMC) systems (see chart "Y2K Quarterly Performance Metrics");
- ❑ improve IT infrastructure service delivery to provide increased capability and efficiency while maintaining a customer rating of "satisfactory" (above 3.67 on a 5-point scale) (see chart "Customer Satisfaction Metric"); and
- ❑ hold costs per resource unit to the FY 1998 level (see charts "NISN Unit Cost Metric," and "NACC Unit Cost Metric").

### Financial Management

This area includes all Agency budget and accounting activities. NASA has established two performance measures for financial management. One focuses on the planning and use of budget resources and the other on the payment process.

#### Financial Resources Used Performance Measure

The planning and use of budgetary resources are critical activities. NASA must effectively plan, control, distribute, and use available resources in



a timely manner, consistent with legal and policy guidelines. A key metric is the rate of use during the performance period. Fund usage is measured by the percentage of costs incurred of financial resources available. The use of available financial resources is significantly influenced by the unpredictable nature of highly technical research and development activities. In recognition of this, a significant proportion of NASA's appropriations are normally available for obligation for a two-year period.

This metric focuses on efforts to optimize investment strategies and systems for use of financial resources and to align financial resources with customer requirements. The target level of performance is to gain performance (i.e. incur cost) totaling 70 percent or more of available financial resources. Such resources include those against which costs have not been incurred from prior years, and new appropriations. Costs incurred include costs used for capital acquisition. In FY 1998, the financial resource usage rate reached 82 percent. See chart "Financial Resources Used."

#### Timely Bill Payment Performance Measure

NASA pays vendors' invoices in a timely and accurate manner. This is a critical part of proper management of financial resources. Prompt, accurate payment of vendors is also a critical element in the maintenance and enhancement of working relationships between NASA and industry.

NASA's payment performance measure focuses on the percentage of vendor dollar billing paid on time. It requires supporting capabilities from program and administrative officials; timely, accurate, reliable information; and an efficient, integrated financial management system. See chart "Timely Bill Payment."

### Provide Aero-Space Products and Capabilities

#### Mission, Goals, and Objectives

This process is the means by which NASA's Strategic Enterprises and their Centers deliver systems (aeronautics, space, and ground), tech-

nologies, data, and operational services to NASA customers so they can conduct research, explore and develop space, and improve life on Earth. The Agency uses the process to answer fundamental questions:

- ❑ What cutting edge technologies, processes, techniques, and engineering capabilities must we develop to enable our research agenda in the most productive, economical, and timely manner?
- ❑ How can we most effectively transfer the knowledge we gain from our research and discoveries to commercial ventures in the air, in space, and on Earth?

The goal of the process is to:

- ❑ enable NASA's Strategic Enterprises and their Centers to deliver products and services to customers more effectively and efficiently while extending the technology, research, and science benefits broadly to the public and commercial sectors;
- ❑ reduce the cost and development time to deliver products and operational services that meet or exceed customers' expectations;
- ❑ seek out and apply innovative approaches, in cooperation with NASA partners and customers, to enable ambitious new science, aeronautics, and exploration missions;
- ❑ focus on integrated technology planning and technology development driven by Strategic Enterprise and customer needs;
- ❑ facilitate the insertion of technology into all programs and proactively transfer technology, form commercialization partnerships, and integrate all innovative approaches to strengthen U.S. competitiveness;
- ❑ improve and maintain NASA's engineering capability, so that NASA will be recognized as the leading aerospace engineering research and development organization in the world; and
- ❑ capture and preserve engineering and tech-

nological best practices and process knowledge to improve continuously NASA's program/project management.

This process enables the Strategic Enterprises to reduce development cost and time for cutting edge technology to enable increased opportunities for research, exploration, and discovery.

#### Accomplishments and Performance Measures

This process has developed a comprehensive Program Management Development Process (NASA Program guidance 7120.5A) and is currently reassessing its process to establish appropriate measures for faster, better, and cheaper performance.

##### Percentage of NASA R&D Program Involved in Partnerships Performance Measure

This metric assesses the quality and alignment with customer needs of NASA technology development by measuring the percentage of R&D program in partnership with industry. The Agency goal is to have 10 to 20 percent of the dollar value of the total R&D program involved in partnerships. This metric is managed by the Aero-Space Technology Enterprise. In the future, separate measures will be established for this metric. NASA is now establishing the process for measuring performance in this area. The formal process for data collection for this metric will be put in place and a baseline will be established in FY 1999.

#### Generate Knowledge

##### Mission, Goals, and Objectives

The Generate Knowledge (GK) process extends the boundaries of knowledge in science and engineering, captures new knowledge in useful and transferable media, and disseminates new knowledge to NASA's varied customers in academia, industry, Government, and the public. Project implementation is carried out in the Produce Aerospace Products and Capabilities process, and dissemination of knowledge is coordinated with the Communicate Knowledge process.

The goals and objectives of the GK process are in nine subprocesses:

- ❑ **Acquire Advice**—acquire advice on priorities for knowledge acquisition through formal and informal mechanisms from groups representing all customers for NASA knowledge products.
- ❑ **Plan and Set Priorities**—develop strategic and implementation plans, based on advice received and other considerations, that articulate the rationale for knowledge acquisition and the strategies for acquiring knowledge.
- ❑ **Select and Fund/Conduct Research Programs**—select and fund internal and external science and technology research programs that are part of, complement, or support the acquisition of knowledge through development programs.
- ❑ **Select and Implement Flight Missions**—formulate, approve, and execute flight missions, and select and fund scientific investigations and investigators in support of Agency research objectives.
- ❑ **Analyze Data (Initial)**—conduct the initial analysis that permits an evaluation of the quality of data acquired and yields the first knowledge products.
- ❑ **Publish, Patent, and/or Broadly Disseminate Results**—publish, patent, and otherwise broadly disseminate the scientific and technical knowledge resulting from these programs in forms accessible by and useful to the science and technology communities.
- ❑ **Create Data Archives**—create data archives that are easily accessible by and useful to the science and technology communities.
- ❑ **Conduct Further Research**—fund internal and external research programs to derive knowledge from the full suite of data sets and other information produced by flight and non-flight research programs.
- ❑ **Assess Research Programs**—periodically assess internal and external research pro-

grams for quality, progress, and relevance to NASA strategic goals.

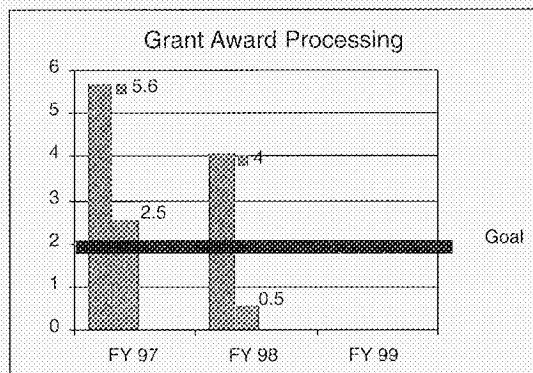
#### Accomplishments and Performance Measures

The GK process encompasses scientific and technical progress in many fields, including space and Earth science, space laboratory science, and basic and applied space technology. This progress is accomplished through flight experiments, and laboratory and theoretical studies. Outcomes of the diverse research activities in the GK process are evaluated in terms such as the following:

- ❑ Do funded research projects address NASA's objectives as expressed in their originating program solicitations in a balanced way that can support scientific or technical advancement across a broad but directly relevant front?
- ❑ Was the yield of supported research commensurate with the level of NASA investment relative to reasonable standards of productivity?
- ❑ Was the state of knowledge in relevant NASA strategic plan areas significantly advanced by the supported projects?
- ❑ Did NASA-supported research produce major advancements that (1) were not or could not be foreseen in initial project proposals or planning, (2) resulted in cross-disciplinary or synergistic value not anticipated at the outset when funding was provided, or (3) provoked unusual interest in the political system or general public as indicated by some objective measure (e.g., cover stories in mass publications, NASA website hits, Administration or Congressional impetus for Agency funding augmentation)?

#### Grant Award Processing Performance Measure

Process performance can be measured in the timeliness and efficiency of delivery of funds to successful research proposers. One such metric measures the time elapsed between the selection, by the NASA Selecting Official, of winning proposals and the receipt of funds by the



grantees' research institution. The goal is to decrease this time to two months while maintaining quality in the selection, funding, and oversight process. In 1997, this process required a minimum of 2.5 months and a maximum of 5.6 months. In 1998, this process improved to a minimum of 0.5 months and maximum of 4.0 months. See chart "Grant Award Processing."

## Communicate Knowledge

### Mission, Goals, and Objectives

NASA uses this process to increase understanding of science and technology, advance its broad application, and inspire achievement and innovation. This process also ensures that the knowledge derived from NASA's research and development programs is presented and transmitted to meet the specific needs and interests of the public and NASA's constituency groups.

The goal of this process is to ensure that NASA's customers receive the information derived from the Agency's research and development efforts that they want, when they want it, for as long as they want it.

This process addresses two objectives:

- ☐ highlight existing and identify new opportunities for customers, including the public, the academic community, and the Nation's students, to directly participate in the space research and discovery experience; and
- ☐ improve the external constituent communities' knowledge, understanding, and use of the results and opportunities associated with NASA's programs.

### Accomplishments and Performance Measures

The Communicate Knowledge Process Team, formed in May 1997, concluded over one year of 274 research and technical interviews at 27 locations which examined the ways NASA relays the knowledge it gains from research programs and projects to various segments of the public.

In August, the team published a report summarizing findings and making recommendations to establish a formal communication process at NASA. The report cites 49 exemplary Communicate Knowledge practices at NASA, categorized under management, partnerships, technology transfer, science transfer, education, public affairs, archives/databases, and communication.

During FY 1998, various functional offices and Enterprise outreach offices made significant strides in communicating NASA's accomplishments. The public readily identifies NASA with accomplishments in the Human Exploration and Development of Space Enterprise, and the Space Science Enterprise. Significant progress was made to increase the visibility of the Earth Science Enterprise's accomplishments in environmental research and NASA's contributions through its Aero-Space Technology Enterprise.

Between 1996 and 1998, the Earth Science Enterprise increased the number of annual press releases from eight to 34 and direct interviews with scientists on network television from four to 60, while producing 14 broadcast videoclips and numerous storm images for use on network news programs. It developed fact sheets on climate issues; contributed to science educational television programs; and provided educational programs in schools, teacher workshops, and an educator conference. In addition, the Enterprise held four regional climate change assessment workshops.

The Enterprise's shuttle radar topography program, which was a joint venture with the National Imagery and Mapping Agency to map the world in three dimensions, was presented to the Nation through exhibits, scientific conferences, and numerous media. El Niño became a household word.

NASA continually transfers knowledge to the aeronautics industry. NASA's Aero-Space Technology Enterprise held its first public forum relating the relevance of its research to industry, other Government agencies, academia, and the press in 1998. The Enterprise issued a progress report to 300 conference attendees and 50,000 open-house attendees with concurrent cybercasting. During 1998, both the Enterprise website and its commercial technology website increased public usage by one third.

The Commercial Technology Program developed an operating manual and established a nationwide outreach plan. The program set up a comprehensive website for commercialization, and identified 4,000 active partnerships in private industry for technology transfer in FY 1998.

For the educational community, the aeronautics program replicated its Mobile Aeronautics Education Laboratory for three more sites. The laboratory is a student activity with 14 stations that apply science, math, geography, reading, and teamwork to aeronautics activities.

Two functional offices also made noteworthy strides in communicating NASA's knowledge to the public.

NASA's Agency-wide Scientific and Technical Information (STI) Program sponsored two new initiatives, the NASA Image eXchange (NIX) and the STI Help Desk.

NIX is an on-line collection of NASA's photographs, digital images, and animation which allows searching of the photographic databases at 10 NASA Centers. It contains more than 450,000 images, using standard key words or browse categories. NIX provides a customer desk to assist users with specific requests. To date, 99 percent of all inquiries have been answered within one day of receipt. See the NIX website at <http://nix.larc.nasa.gov>.

The STI Help Desk, which receives more than 20,000 scientific and technical customer inquiries yearly, handles requests from NASA and its contractors, universities, aerospace companies, and the public for copies of NASA's scientific and technical information from the STI Database. The STI Database houses more than 3.5 million citations of NASA, U.S., and international scientific and technical documents. Ninety-eight percent of inquiries from the public are handled within three days. See the STI website at <http://www.sti.nasa.gov>.

NASA's History Office used the celebration of NASA's 40th birthday to inspire a wide spectrum of commemorative activities across the country communicating NASA's knowledge. An anniversary event for all NASA employees and a gala inaugurated a year-long celebration. The anniversary is receiving significant international press coverage and triggering a round of exhibits heralding NASA's accomplishments, including a year-long interactive exhibit in Disneyland's Tomorrowland featuring the Mars Rover and Mars Lander. Monopoly created a U.S. Space Program edition.

# Compliance with Legal and Regulatory Financial Requirements

This section provides information on NASA's compliance with the:

- ☐ Federal Managers' Financial Integrity Act (FMFIA),
- ☐ Inspector General Act Amendments,
- ☐ Federal Financial Management Improvement Act (FFMIA),
- ☐ Prompt Payment Act,
- ☐ Civil Monetary Penalty Act, and
- ☐ Debt Collection Act.

## Federal Managers' Financial Integrity Act (FMFIA)

The Federal Managers' Financial Integrity Act (FMFIA) requires Agencies to annually provide a statement of assurance regarding management controls and financial systems.

NASA's management controls and financial systems, taken as a whole, provide reasonable assurance that the objectives of *Sections 2 and 4 of the FMFIA* have been achieved. These conclusions are based on the review and consideration of a wide variety of evaluations, internal analyses, reconciliations, reports, and other information, including quality assurance, General Accounting Office and Office of the Inspector General audits, an independent public accountant's (IPA's) opinion on our financial statements and the IPA's reports on compliance with laws and regulations.

NASA is pleased to report continued progress in strengthening management controls in spite of downsizing, and budget pressures that result in greater management risk. Examples are: (1) a complete revision and expansion of the program/project management process; (2) an Agency-level effort to streamline and consolidate the grants management process; (3) corrective actions to improve information technology security; and (4) three Centers

have obtained third-party International Organization for Standardization (ISO 9001) certification. All Centers and NASA Headquarters will be ISO 9001 certified for critical processes by the end of FY 1999.

The Capital Investment Council has established and implemented a process for reviewing Functional Leadership Strategies and individual Functional Leadership Initiatives. Sponsors of major initiatives are establishing Program Commitment Agreements (PCA) with the Administrator and the Program Management Council oversees implementation of PCA's for the Administrator.

Our conclusion that NASA has reasonable controls does not mean that NASA is without management improvement opportunities. Audits, internal reviews, and other evaluations have revealed management weaknesses in individual systems. We are aggressively correcting identified weaknesses.

## Status of Material Weakness and Significant Areas of Concern

NASA is continuing to increase its level of effort on three previously reported significant areas of concern, and has added two new significant areas of concern (described below).

**Financial Management Systems:** This year NASA has reduced the material weakness in financial management systems to a significant area of concern. This is because NASA has achieved compliance with Federal accounting principles, Standard General Ledger requirements, and Federal financial system standards. Improvements have been made in establishing a single Agency-wide financial management system, and assurance has been provided by IPA financial audits over the past several years. Also, NASA has responded to "reportable conditions" identified by its independent public accountant (IPA) by strengthening coordination with Centers to ensure implementation of new accounting policies and procedures and by

establishing a new process to secure and resolve all audit findings.

**Equitable Environmental Cost Sharing:**

NASA issued an Agency-level directive (NPG 8850) establishing requirements, responsibilities, procedures, and guidelines related to the identification of Potentially Responsible Parties (PRP) and the development of cost-sharing or cost-recovery arrangements with PRPs. Ames Research Center entered into a settlement agreement with the Navy and three private companies to cleanup a Superfund site. Marshall Space Flight Center (MSFC), and two other NASA facilities [Plum Brook Station (PBS), and Wallops Flight Facility (WFF)] have reached agreements with the Army for cleanup of formerly utilized defense sites. The MSFC agreement is awaiting approval of the U.S. Environmental Protection Agency. Cleanups at PBS and WFF are under state regulatory authority. Cleanup agreements are currently being negotiated at the Jet Propulsion Laboratory (JPL) and Stennis Space Center (SSC). During 1999, NASA will initiate the process to notify formally other PRPs at the Santa Susana Field Laboratory, in part a NASA facility, and conduct preliminary PRP analyses at the other NASA Centers.

**Information Technology (IT) Security:**

With participation by expert outside staff, NASA conducted a comprehensive review of its IT security posture. The review produced 33 recommendations, all accepted by the Agency's Acting Deputy Administrator, to further strengthen NASA's IT security. An implementation plan for the recommendations has been prepared and is under review. Included in the recommendations was the creation of an IT Security Council, composed of senior Agency management officials, to provide executive-level guidance in improving IT security.

In 1998, a new IT security policy directive was issued. The related procedures and guidelines document is in final review and will be issued. The Agency piloted a public key infrastructure for digital signature, authentication, and encryption, now ready for full implementation. NASA implemented firewalls at all Centers and at Headquarters.

NASA also worked with GAO on its audit of the Agency's IT security, which included penetration testing. NASA has also worked with its independent public accountant (IPA) on financial systems IT weaknesses that the IPA considers in total to constitute a "reportable condition." NASA prepared an IT security training awareness course. The CD-ROM to be used for this course is in final Beta testing before distribution. We conducted an Agency-wide workshop on IT security, bringing together from all NASA Installations key personnel involved in the provision of IT security. NASA also is establishing a metrics program that will assist in determining the adequacy of the measures we take to ensure IT security. The NASA Administrator has issued a memorandum to all senior management officials stressing the importance of reporting IT security incidents.

In FY 1999, the Agency will enhance IT security training for system administrators and project managers; deploy its public key infrastructure for signature, authentication, and encryption; hire a senior IT security person for the NASA CIO's staff; enhance its incident detection and response mechanism; begin a regular program of penetration testing; review IT security-related directives; and modify or clarify IT security roles, responsibilities, and commitments, as needed.

**Year 2000 (Y2K) Program:** NASA initiated a Y2K program in August 1996 to address the challenges imposed on Agency software, hardware, and firmware systems by the new millennium. As of October 31, 1998, 76 percent of NASA mission critical systems are or have been made Y2K compliant. Implementation of Y2K compliant mission critical systems and components is planned to be complete by March 1999, allowing nine months of operation prior to the new millennium.

During FY 1999, NASA's planned activities include: complete validation and implementation of systems that have been remediated and certify the Y2K compliance of NASA inventory items; conduct end-to-end tests and/or high fidelity simulations for major programs; complete business continuity and contingency plans for major programs and core functions;

This report is included for the first time in the NASA Accountability Report. It is required by Section 106 of the Inspector General Act Amendments (P.L. 100-504). This report provides information on overall progress on audit followup and internal management controls and provides statistics for the second half of FY 1998 on audit reports with disallowed costs and on audit reports with funds to be put to better use (Table I). It pro-

Table I. DISALLOWED COST AND FUNDS PUT TO BETTER USE APRIL 1, 1996 THROUGH SEPTEMBER 30, 1998

Category		Number	Value	Number	Value
A. AUDIT REPORTS WITH MANAGEMENT DECISIONS ON WHICH FINAL ACTION HAD NOT BEEN TAKEN AT THE BEGINNING OF THE PERIOD	A. AUDIT REPORTS WITH DISALLOWED COSTS	2	\$769,411	6	\$35,001,824
	B. AUDIT REPORTS WITH RECOMMENDATIONS THAT FUNDS BE PUT TO BETTER USE	0	\$0	5	\$44,856,000
C. Total audit reports pending final action during the period (total of A + B)		2	\$769,411	11	\$79,857,824
D. Audit reports with final action during the period					
1. Value of disallowed costs collected by management		0	\$0		
2. Value of disallowed costs written off by management		0	\$0		
3. Total (lines D1 + D2)		0	\$0		
4. Value of implemented recommendations (completed)				5	\$12,297,626
5. Value of recommendations that management concluded should not be implemented or completed				0	\$0
6. Total (lines D4 + D5)				5	\$12,297,626
E. Audit reports needing final action at the end of the period (C - D)		2	\$769,411	6	\$67,560,198

Note: This table covers the second half of FY 1998 only. The first half was issued in the NASA Semiannual Management Report on the Status of Audit Followup for the period October 1, 1997, through March 31, 1998. Call (202) 358-2260 for a copy.

and resolve any potential Y2K implications with NASA contractors, business partners, and international partners.

**Cost Benefit Analysis:** NASA recognizes the important role that cost-benefit analyses play in investment decisions. In support of the Outsourcing Desktop Initiative for NASA (ODIN), the NASA CIO sponsored a business case analysis which indicated the potential of outsourcing for desktop computing envi-

ronments. Results of our delivery order solicitation process for ODIN demonstrate that NASA has lowered the cost of such services to NASA. The Langley Research Center has been selected to develop and implement (in FY 99) an institutional capability to conduct, or support the conduct of, business cases for Agency, as well as Center-specific IT investments.

NASA is undertaking a full scale Office of Management and Budget Circular No. A-76 study to determine the least expensive method of satisfying the Agency's air transportation needs. Completion of the A-76 study at Marshall Space Flight Center is scheduled for FY 1999. Based on the results of that study, A-76 studies will be undertaken at the rest of NASA's Centers.

## NASA Commitment to

## Strong Management Controls

NASA is committed to improve continuously the management of programs and related controls independently. Further, NASA is committed to removing unnecessary, burdensome requirements and controls while evaluating streamlined processes to ensure reasonable controls remain in place. NASA is committed to improving every aspect of management.

## The Inspector General Act Amendments

The Inspector General (IG) Act (as amended) requires semiannual reporting on IG audits and related activities as well as Agency followup.

Table II. SUMMARY OF AUDIT ACTIVITIES  
OCTOBER 1, 1997 - SEPTEMBER 30, 1998

Audits Open as of October 1, 1997	17
Audits Issued During FY 1998	41
Audits Closed During FY 1998	(28)
Audits Open as of September 30, 1998	30
Audits Open Over One Year	7

vides information on the status of audit reports open at the beginning of the year, and audit reports issued and closed during the year (Table II). It also discusses each of the seven audits over one year old still open on September 30.

### Audit Followup and Internal Management Controls

Effective audit followup and internal management controls are a high priority for all levels of NASA management. In conjunction with the Office of the Inspector General (OIG), we strive to identify and correct deficiencies as early as possible. In accordance with the tenets of the National Performance Review, we continue to collaborate with the OIG to discover new and better processes that will best serve the needs of NASA and the general public. This year, the OIG addressed current issues and answered questions at our annual Training Conference,

while we participated in an OIG audit directors management meeting.

NASA management is working with the OIG to develop requirements for an integrated audit tracking system to provide complete, accurate status of audit activity. We established an electronic service that allows management and the OIG to deliver reports and other information effectively and efficiently, transmitting audit information to the widest possible audience minutes after document release.

### Summary of Audit Activities for FY 1998

The period began with a total of 17 audits without final resolution. Two of these audits are currently under OIG criminal and civil investigation. Once these investigations are concluded, management will seek closure of the audit issues. Management and the OIG are in various stages of resolution on the remaining 15 audits.

The OIG issued a total of 41 audits during this reporting period. Management worked with the OIG to close 28 during the period. This is noteworthy since 17 were issued in the last month of the period. Management worked closely with the OIG to close five of the 17 upon issuance.

### DISCUSSION OF AUDITS OPEN OVER ONE YEAR

#### Report No. LA-95-001, NASA Aircraft Management, dated 03/28/95

There are two remaining recommendations that require extensive aircraft inventories involving all NASA Centers, OMB reporting requirements and lengthy cost/benefit analyses on administrative aircraft operations. The audit report has recommendations that funds be put to better use totaling \$16,400,000.

#### Report No. JP-95-005, Travel Policy, Procedures and Practices, dated 09/15/95

There are two remaining open recommendations which management requested OIG closure concurrence on 11/24/98. The audit report has recommendations, with disallowed costs totaling \$661,146, that funds be put to better use totaling \$1,034,000.

#### Report No. IG-97-011, Shuttle Processing Contract Circumstances Indicating Procurement Fraud, dated 12/20/96

This is currently under OIG criminal and civil investigation. The audit report has recommendations that funds be put to better use totaling \$2,076,000.

#### Report No. IG-97-020, Privatization of NASA's Sounding Rocket Program, dated 03/27/97

NASA management agreed with the recommendation of implementing a cost comparison as part of the overall procurement process. Management will coordinate the contract award decision with the OIG. Completion of action on this recommendation is scheduled for November 1998.

#### Report No. IG-97-026, Commercial Use of NASA's Tracking and Data Relay Satellite System, dated 06/24/97

NASA management concurred with all recommendations. One recommendation was closed on 11/18/98; management is pursuing closure on two and the fourth is under OIG investigation. Recommendations with disallowed costs total \$108,265.

#### Report No. IG-97-028, Technology and Applications Programs' Bid and Proposal, dated 06/25/97

Management nonconcurred with the two recommendations, however, one was subsequently closed. Management requested closure concurrence from the OIG on 6/3/98 and is awaiting an OIG response on the second recommendation. The audit report has recommendations that funds be put to better use totaling \$5,400,000.

The remaining 12 are with appropriate organizations for resolution.

At the end of this reporting period, there were 30 audits with open recommendations. It is management's goal to close recommendations no later than six months from the date of issuance of the final report. Management and the OIG continue to discuss ways to improve this process and resolve open issues in a more timely manner.

Through new and innovative programs such as electronic transfer of reports, improved tracking systems, and cooperation with the OIG, we will continue to see a reduction in open recommendations and improved implementation of corrective action.

## Federal Financial Management Improvement Act (FFMIA)

This Act requires agencies to report on agency substantial compliance with Federal financial management system requirements, Federal accounting standards, and the U. S. Government Standard General Ledger. NASA substantially complies with the Federal Financial Management Improvement Act.

### Prompt Payment

This Act requires agencies to report on their efforts to pay bills on time.

In FY 1998, NASA processed 98 percent of its 186,789 payments on time, representing approximately \$11 billion. There were 2,029 interest penalty payments, a decrease of 223 over FY 1997. The Agency paid only \$7.13 in interest penalties for every \$1 million disbursed in FY 1998, compared to \$7.75 in 1997.

Virtually all recurring payments are processed electronically. We are working with our payment centers to maximize electronic payment for all vendors and have established goals for full implementation of the electronic funds transfer (EFT) provisions of the Debt Collection Improvement Act of 1996. NASA has fully implemented the EFT provisions of the Debt Collection Improvement Act of 1996 effective January 1999, in accordance with the Act and Treasury regulations.

### Civil Monetary Penalty Act

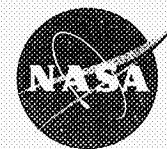
There were no Civil Monetary Penalties assessed by NASA during the relevant financial statement reporting period.

### Debt Collection Act

Accounts Receivable totaled \$158.5 million at September 30, 1998. Of that amount, \$153.8 million was receivable from other Federal agencies. The remaining \$4.7 million was receivable from the public.

# Auditors' Reports

National Aeronautics and  
Space Administration  
**Headquarters**  
Washington, DC 20546-0001



Reply to Attn of: W

FEB 18 1999

TO: A/Administrator  
B/Chief Financial Officer

FROM: W/Inspector General


SUBJECT: Audit of the National Aeronautics and Space Administration's Fiscal Year 1998 Financial Statements

We contracted with Arthur Andersen LLP, an independent certified public accounting firm, to audit the NASA Fiscal Year 1998 Financial Statements. The contract required that the audit be done in accordance with government auditing standards and with Office of Management and Budget Bulletin 98-08, as amended, "Audit Requirements for Federal Financial Statements."

In its audit report dated February 3, 1999, Arthur Andersen issued an unqualified opinion on NASA's financial statements. Additionally, Arthur Andersen found no material weaknesses<sup>1</sup> in internal controls, and no reportable noncompliance with the laws and regulations it tested.

To ensure the quality of the audit work performed, we monitored the progress of the audit at key points and reviewed Arthur Andersen's report and related working papers to ensure compliance with applicable standards. Our review, as differentiated from an audit in accordance with generally accepted government auditing standards, was not intended to enable us to express, and we do not express, opinions on NASA's financial statements or on conclusions about the effectiveness of internal controls or conclusions on compliance with laws and regulations. Arthur Andersen is responsible for the attached auditor's report (see Enclosure) and the conclusions expressed in the report. However, our review disclosed no instances in which Arthur Andersen did not comply, in all material respects, with applicable standards and mandated requirements.

Please contact me or Mr. Russell A. Rau, Assistant Inspector General for Auditing, at 358-1232, if you have any questions concerning our review.

  
Roberta L. Gross

Enclosure

<sup>1</sup> A material weakness is a reportable condition in which the design or operation of one or more of the internal control structure elements does not reduce to a relatively low level the risk that errors or irregularities in amounts that would be material in relation to the financial statements being audited may occur and not be detected within a timely period by employees in the normal course of performing their assigned functions.

# ARTHUR ANDERSEN LLP

## Report of Independent Public Accountants on Financial Statements

To the Inspector General of the  
National Aeronautics and Space Administration:

We have audited the accompanying Statement of Financial Position of the National Aeronautics and Space Administration (NASA) as of September 30, 1998 and 1997, and the related Statements of Net Cost, Changes in Net Position, Budgetary Resources and Financing for the year ended September 30, 1998. These financial statements are the responsibility of NASA's management. Our responsibility is to express an opinion on these financial statements based on our audits.

We conducted our audits in accordance with generally accepted auditing standards, the standards for financial audits contained in *Government Auditing Standards* (1994 Revision), issued by the Comptroller General of the United States, and Office of Management and Budget (OMB) Bulletin No. 98-08, "Audit Requirements for Federal Financial Statements," as amended. Those standards require that we plan and perform the audit to obtain reasonable assurance about whether the financial statements are free of material misstatement. An audit includes examining, on a test basis, evidence supporting the amounts and disclosures in the financial statements. An audit also includes assessing the accounting principles used and significant estimates made by management, as well as evaluating the overall financial statement presentation. We believe that our audits provide a reasonable basis for our opinion.

As described in Note 1 to the financial statements, the accounting policies used by NASA to prepare these financial statements are in accordance with OMB Bulletin No. 97-01, "Form and Content of Agency Financial Statements," as amended, which is a comprehensive basis of accounting other than generally accepted accounting principles.

In our opinion, the financial statements referred to above present fairly, in all material respects, the financial position of NASA as of September 30, 1998 and 1997, and its net cost, changes in net position, budgetary resources and financing for the year ended September 30, 1998, in conformity with the comprehensive basis of accounting described in Note 1.

As explained in Note 1 to the financial statements, effective October 1, 1997, NASA implemented Statement of Federal Financial Accounting Standards (SFFAS) No. 4, "Managerial Cost Accounting Concepts and Standards for the Federal Government," SFFAS No. 6, "Accounting for Property, Plant, and Equipment," SFFAS No. 7, "Accounting for Revenue and Other Financing Sources and Concepts for Reconciling Budgetary and Financial Accounting" and SFFAS No. 8, "Supplementary Stewardship Reporting."

The Required Supplementary Stewardship Information is not a required part of the basic financial statements but is supplementary information required by OMB Bulletin No. 97-01, as amended. We have applied certain limited procedures that consisted principally of inquiries of management regarding the methods of measurement and presentation of the supplementary information. However, we did not audit the information and express no opinion on it.

We have also issued separate reports dated February 3, 1999, on NASA's internal control and on its compliance with laws and regulations.

*Arthur Andersen LLP*

Vienna, Virginia  
February 3, 1999

# ARTHUR ANDERSEN LLP

## Report of Independent Public Accountants on Internal Control

To the Inspector General of the  
National Aeronautics and Space Administration:

We have audited the Statement of Financial Position of the National Aeronautics and Space Administration (NASA) as of September 30, 1998 and 1997, and the related Statements of Net Cost, Changes in Net Position, Budgetary Resources and Financing for the year ended September 30, 1998, and have issued our report thereon dated February 3, 1999. We conducted our audits in accordance with generally accepted auditing standards, the standards applicable to financial audits contained in *Government Auditing Standards* (1994 Revision), issued by the Comptroller General of the United States, and Office of Management and Budget (OMB) Bulletin No. 98-08, "Audit Requirements for Federal Financial Statements," as amended. Those standards require that we plan and perform the audit to obtain reasonable assurance about whether the financial statements are free of material misstatement.

In planning and performing our audit of the financial statements of NASA for the year ended September 30, 1998, we obtained an understanding of NASA's internal control over financial reporting. With respect to the internal control over financial reporting, we obtained an understanding of the design of relevant policies and procedures and whether they have been placed in operation, and we assessed control risk in order to determine our auditing procedures for the purpose of expressing an opinion on the financial statements and not to provide assurance on the internal control over financial reporting. Accordingly, we do not express such an opinion.

Under standards issued by the American Institute of Certified Public Accountants, reportable conditions involve matters coming to our attention relating to significant deficiencies in the design or operation of the internal control over financial reporting that, in our judgment, could adversely affect NASA's ability to record, process, summarize and report financial data consistent with the assertions of management in the financial statements. Material weaknesses are reportable conditions in which the design or operation of one or more of the internal control components does not reduce to a relatively low level the risk that misstatements in amounts that would be material in relation to the financial statements being audited may occur and not be detected within a timely period by employees in the normal course of performing their assigned functions. We noted a matter discussed in the following paragraph involving the internal control over financial reporting and its operation that we consider to be a reportable condition. This matter is more fully described in a separate letter to the Inspector General and the Administrator of NASA dated February 3, 1999.

- NASA's information technology policies and procedures continue to require improvement to ensure that controls over financial management systems are properly designed and operating effectively to prevent unauthorized access to certain NASA financial management applications and data.

Our consideration of the internal control over financial reporting would not necessarily disclose all matters in the internal control over financial reporting that might be reportable conditions and, accordingly, would not necessarily disclose all reportable conditions that are also considered to be material weaknesses as defined above. However, we believe that the reportable condition described above is not a material weakness.

In addition, we considered NASA's internal control over Required Supplementary Stewardship Information by obtaining an understanding of NASA's internal control, determining whether those internal controls had been placed in operation, assessing control risk and performing tests of controls as required by OMB Bulletin No. 98-08, as amended. Our procedures were not designed to provide assurance on these internal controls. Accordingly, we do not express such an opinion.

## ARTHUR ANDERSEN LLP

Lastly, with respect to internal controls related to performance measures reported in the section entitled "NASA Performance," we obtained an understanding of the design of significant internal controls related to the existence and completeness assertions as required by OMB Bulletin No. 98-08, as amended. Our procedures were not designed to provide assurance on the internal control over reported performance measures, and, accordingly, we do not express such an opinion.

We also noted other matters involving the internal control over financial reporting and its operation that we have reported to the Inspector General and the Administrator of NASA in a separate letter dated February 3, 1999.

This report is intended solely for the information and use of the Inspector General, the Administrator and management of NASA, OMB and Congress, and is not intended to be and should not be used by anyone other than these specified parties.

Vienna, Virginia  
February 3, 1999

*Arthur Andersen LLP*

# ARTHUR ANDERSEN LLP

## Report of Independent Public Accountants on Compliance with Laws and Regulations

To the Inspector General of the  
National Aeronautics and Space Administration:

We have audited the Statement of Financial Position of the National Aeronautics and Space Administration (NASA) as of September 30, 1998 and 1997, and the related Statements of Net Cost, Changes in Net Position, Budgetary Resources and Financing for the year ended September 30, 1998, and have issued our report thereon dated February 3, 1999. We conducted our audits in accordance with generally accepted auditing standards, the standards for financial audits contained in *Government Auditing Standards* (1994 Revision), issued by the Comptroller General of the United States, and Office of Management and Budget (OMB) Bulletin No. 98-08, "Audit Requirements for Federal Financial Statements," as amended. Those standards require that we plan and perform the audit to obtain reasonable assurance about whether the financial statements are free of material misstatement.

Compliance with laws and regulations applicable to NASA is the responsibility of NASA's management. As part of obtaining reasonable assurance about whether the statements referred to above are free of material misstatement, we performed tests of NASA's compliance with provisions of certain laws and regulations, noncompliance with which could have a direct and material effect on the determination of financial statement amounts, and certain other laws and regulations specified in OMB Bulletin No. 98-08, as amended, including the requirements referred to in the Federal Financial Management Improvement Act (FFMIA) of 1996.

Under FFMIA, we are required to report whether NASA's financial management systems substantially comply with 1) Federal financial management systems requirements, 2) applicable Federal accounting standards and 3) the requirement to record transactions consistent with the United States Government Standard General Ledger at the transaction level. To meet this requirement, we performed tests of compliance using the implementation guidance for FFMIA included in Appendix D of OMB Bulletin No. 98-08, as amended.

The results of our tests disclosed no instances of noncompliance that are required to be reported herein under *Government Auditing Standards* or OMB Bulletin No. 98-08, as amended. Additionally, the results of our tests disclosed no instances in which NASA's financial management systems did not substantially comply with the three requirements of FFMIA described in the preceding paragraph. However, the objective of our audit of the financial statements was not to provide an opinion on compliance with provisions of certain laws and regulations. Accordingly, we do not express such an opinion.

Additionally, the objective of our audit of the financial statements was not to determine whether NASA's systems are Year 2000 compliant. NASA management is solely responsible for Year 2000 compliance for its systems and any other systems that impact NASA's operations, such as those of NASA's vendors, service providers or other third parties. Accordingly, we have no responsibility to determine, and provide no assurance on, whether NASA has addressed or will be able to address the affected systems on a timely basis.

This report is intended solely for the information and use of the Inspector General, the Administrator and management of NASA, OMB and Congress, and is not intended to be and should not be used by anyone other than these specified parties.

Vienna, Virginia  
February 3, 1999

*Arthur Andersen LLP*

# Financial Statements

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## Introduction to Financial Statements

These financial statements reflect the overall financial position of NASA offices and activities, including assets and liabilities, and the results of operations, pursuant to the requirements of 31 U. S. C. 3515b. The statements have been prepared from NASA's books and records.

These statements are in addition to separate financial reports prescribed by the Office of Management and Budget (OMB) and the U.S. Department of the Treasury that are used to monitor and control budgetary resources, which are prepared from the same books and records. The statements should be read with the understanding that they are for a component of the U. S. Government, a sovereign entity. For example, NASA's Fund Balance is held by Treasury, another Federal agency. Also, NASA has no authority to pay liabilities not covered by budgetary resources. Liquidation of such liabilities requires enactment of an appropriation.

For FY 1998, NASA is reporting under five new financial statement formats prescribed by OMB in response to Statements of Federal Financial Accounting Standards recommended by the Federal Accounting Standards Advisory Board and approved by OMB, U.S. Department of the Treasury, and the General Accounting Office.

The **Statement of Financial Position** is similar to the one prepared for FY 1997, and is analogous to balance sheets reported in the private sector. It provides information on assets, liabilities, and net position.

The **Statement of Net Cost** relates to the Statement of Operations and Changes in Net Position reported for FY 1997, and is analogous to profit and loss statements in the private sector.

The **Statement of Changes in Net Position** expands upon the Statement of Operations and Changes in Net Position reported for FY 1997.

The **Statement of Budgetary Resources** is a new statement for FY 1998 and provides information on how budgetary resources were made available and their status at the end of the year.

The **Statement of Financing** is a new statement for FY 1998 and provides a reconciliation to ensure a proper relationship between budgetary balances and transactions and other financial balances and transactions.

In addition to the five new financial statement formats, the **Required Supplementary Stewardship Information** provides information on NASA's Heritage Assets and on its spending on research and development.

In addition to changing its reporting formats, NASA has changed its accounting principles and practices as required by Federal accounting standards effective for FY 1998. NASA is presenting its programs on a full cost basis and is presenting its assets on a changed basis. These changes include, among others, increases to show the cost of assets in space and decreases for depreciation and for heritage assets, as discussed in footnotes to the financial statements.

NASA received consecutive "Unqualified Opinions" on its financial statements for fiscal years 1994, 1995, 1996, 1997, and 1998. The first two were from NASA's Inspector General. The last three were from an independent public accounting firm. These were major milestones in NASA's continuing quest for financial management excellence.

**National Aeronautics and Space Administration**  
**Statement of Financial Position**  
**as of September 30**  
**(In Thousands)**

<b>Assets:</b>	<b>1998</b>	<b>1997</b>
Intragovernmental Assets:		
Fund Balance With Treasury (Note 2)	\$ 6,256,007	\$ 6,857,980
Investments (Note 3)	16,759	18,416
Accounts Receivable, Net (Note 4)	153,825	170,325
Advances and Prepaid Expenses	4,234	57,018
Total Intragovernmental Assets	<u>6,430,825</u>	<u>7,103,739</u>
Governmental Assets:		
Accounts Receivable, Net (Note 4)	4,662	5,418
Advances and Prepaid Expenses	190	0
Operating Materials and Supplies (Note 5)	2,280,577	2,119,283
Property, Plant, and Equipment, Net (Note 6)	21,367,659	27,593,191
<b>Total Assets</b>	<b><u>\$ 30,083,913</u></b>	<b><u>\$ 36,821,631</u></b>
<b>Liabilities:</b>		
Liabilities Covered by Budgetary Resources:		
Intragovernmental Liabilities:		
Accounts Payable	\$ 275,318	\$ 353,519
Other Liabilities (Note 7)	18,529	46,046
Total Intragovernmental Liabilities	<u>293,847</u>	<u>399,565</u>
Governmental Liabilities:		
Accounts Payable	2,840,341	2,995,942
Other Liabilities (Note 7)	163,481	132,595
Total Liabilities Covered by Budgetary Resources	<u>3,297,669</u>	<u>3,528,102</u>
Liabilities Not Covered by Budgetary Resources:		
Intragovernmental Liabilities:		
Other Liabilities (Note 7)	17,158	4,954
Governmental Liabilities:		
Environmental Cleanup Costs	1,405,372	1,466,784
Actuarial	51,455	56,891
Other Liabilities (Note 7)	239,194	215,778
Total Liabilities Not Covered by Budgetary Resources	<u>1,713,179</u>	<u>1,744,407</u>
<b>Total Liabilities</b>	<b><u>\$ 5,010,848</u></b>	<b><u>\$ 5,272,509</u></b>
<b>Net Position:</b>		
Unexpended Appropriations (Note 9)	\$ 3,116,819	\$ 3,559,741
Cumulative Results of Operations	21,956,246	27,989,381
<b>Total Net Position</b>	<b><u>\$ 25,073,065</u></b>	<b><u>\$ 31,549,122</u></b>
<b>Total Liabilities and Net Position</b>	<b><u>\$ 30,083,913</u></b>	<b><u>\$ 36,821,631</u></b>

The accompanying notes are an integral part of these statements.

**National Aeronautics and Space Administration**  
**Statement of Net Cost**  
**for the Fiscal Year Ended September 30, 1998**  
**(In Thousands)**

**Program/Operating Expenses By Enterprise:**

**Human Exploration and Development of Space:**

Space Shuttle	\$ 3,369,846
Space Station	2,500,525
Life and Microgravity	399,309
U.S./Russian Cooperative	152,625
Payload Utilization and Operations	401,528
Total Human Exploration and Development of Space	<u>6,823,833</u>

**Space Science:**

Space Science	2,288,063
Planetary Exploration	48,322
Total Space Science	<u>2,336,385</u>

**Earth Science:**

Mission to Planet Earth	1,742,607
Total Earth Science	<u>1,742,607</u>

**Aero-Space Technology:**

Aeronautics Research and Technology	1,375,934
Space Access and Technology	678,036
Commercial Programs	143,986
Total Aeronautics and Space Transportation	<u>2,197,956</u>
<b>Total Enterprise Program Costs</b>	<u><b>13,100,781</b></u>

**Costs Not Assigned to Enterprises:**

Mission Communication Services	444,933
Space Communication Services	254,440
Academic Programs	147,583
Other Programs	218,109
Trust Funds	1,457
Reimbursable Expenses (Note 10)	715,407
Total Costs Not Assigned to Enterprises	<u>1,781,929</u>
<b>Total Program Expenses</b>	<u><b>14,882,710</b></u>

**Costs Not Assigned to Programs:**

Change in Unfunded Expenses	(29,923)
Depreciation Expense	2,013,438
Funded Increases in Capitalized Property and Inventory, Net	(2,018,558)
<b>Total Costs Not Assigned to Programs</b>	<u><b>(35,043)</b></u>

Less: Earned Revenues Not Attributable to Programs	(715,407)
<b>Deferred Maintenance (Note 12)</b>	
<b>Net Cost of Operations</b>	<u><u><b>\$ 14,132,260</b></u></u>

The accompanying notes are an integral part of these statements.

**National Aeronautics and Space Administration**  
**Statement of Changes in Net Position**  
**for the Fiscal Year Ended September 30, 1998**  
(In Thousands)

<b>Net Cost of Operations</b>	\$ (14,132,260)
<b>Financing Sources:</b>	
Appropriations Used	14,061,658
Net Property Transfers	(64)
Interest Revenue, Federal	1,493
Imputed Financing	104,548
Other Revenues	25,772
Less: Receipts Transferred to Treasury	(25,772)
<b>Net Results of Operations</b>	<u>35,375</u>
<b>Prior Period Adjustments (Note 11)</b>	(6,068,510)
<b>Net Change in Cumulative Results of Operations</b>	<u>(6,033,135)</u>
<b>Decrease in Unexpended Appropriations</b>	(442,922)
<b>Change in Net Position</b>	<u>(6,476,057)</u>
<b>Net Position-Beginning of Period</b>	31,549,122
<b>Net Position-End of Period</b>	<u><u>\$ 25,073,065</u></u>

The accompanying notes are an integral part of these statements.

**National Aeronautics and Space Administration**  
**Statement of Budgetary Resources**  
**for the Fiscal Year Ended September 30, 1998**  
**(In Thousands)**

**Budgetary Resources:**

Budget Authority	\$ 13,649,576
Unobligated Balances-Beginning of Period	1,067,624
Net Transfers of Prior-Year Balances, Actual	(45)
Spending Authority from Offsetting Collections	630,046
<b>Total Budgetary Resources</b>	<b>\$ 15,347,201</b>

**Status of Budgetary Resources:**

Obligations Incurred	\$ 14,403,873
Unobligated Balances-Available	785,816
Unobligated Balances-Not Available	157,512
<b>Total Status of Budgetary Resources</b>	<b>\$ 15,347,201</b>

**Outlays:**

Obligations Incurred	\$ 14,403,873
Less: Spending Authority from Offsetting Collections	(630,046)
<b>Obligations Incurred, Net</b>	<b>13,773,827</b>
Obligated Balance, Net-Beginning of Period	5,682,252
Less: Obligated Balance, Net-End of Period	(5,249,872)
<b>Total Outlays</b>	<b>\$ 14,206,207</b>

The accompanying notes are an integral part of these statements.

**National Aeronautics and Space Administration**  
**Statement of Financing**  
**for the Fiscal Year Ended September 30, 1998**  
**(In Thousands)**

**Obligations and Nonbudgetary Resources:**

Obligations Incurred	\$ 14,403,873
Less: Spending Authority from Offsetting Collections	(630,046)
Financing Imputed for Cost Subsidies	104,548
<b>Total Obligations as Adjusted and Nonbudgetary Resources</b>	<b><u>13,878,375</u></b>

**Resources That Do Not Fund Net Cost of Operations:**

Change in Amount of Goods, Services, and Benefits Ordered but Not Yet Received or Provided	288,928
Costs Capitalized in the Statement of Financial Position	(2,018,558)
<b>Total Resources That Do Not Fund Net Cost of Operations</b>	<b><u>(1,729,630)</u></b>

**Costs That Do Not Require Resources:**

Depreciation	2,013,438
<b>Total Costs That Do Not Require Resources</b>	<b><u>2,013,438</u></b>

<b>Change in Financing Sources Yet to Be Provided</b>	<b><u>(29,923)</u></b>
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<b>Net Cost of Operations</b>	<b><u>\$ 14,132,260</u></b>
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The accompanying notes are an integral part of these statements.

**National Aeronautics and Space Administration**  
**Notes to Financial Statements**  
**for the Fiscal Year Ended September 30, 1998**

**1. Summary of Accounting Policies and Operations:**

**Reporting Entity**

NASA is an independent agency established to plan and manage the future of the Nation's civil aeronautics and space program. NASA has established four Strategic Enterprises, Space Science, Earth Science, Human Exploration and Development of Space, and Aero-Space Technology, to implement the Agency's mission and communicate with external customers. These financial statements reflect all NASA activities including those of its nine Centers and Headquarters. NASA's Jet Propulsion Laboratory is a federally funded Research and Development Center and its physical assets are owned by NASA, but it is managed by an independent contractor. Financial management of NASA operations is the responsibility of Agency officials at all organizational levels. The accounting system consists of 10 distinct operations located at the Centers and Headquarters. Although each Center is independent of the other and has its own chief financial officer, they operate under Agency-wide financial management policies. These accounting systems provide basic information necessary to meet internal and external budget and financial reporting requirements and provide fund control and accountability. All significant intra-entity activities have been eliminated.

**Basis of Presentation**

These financial statements were prepared to report the financial position and results of operations of NASA as required by the Chief Financial Officers Act of 1990 and the Government Management Reform Act of 1994. They were prepared from the books and records of NASA, in accordance with the comprehensive basis of accounting and NASA's accounting policies and practices summarized in this note. These financial statements were prepared under the accrual basis of accounting, where expenses and revenues are recorded in the accounts in the period in which they are incurred or earned. Certain prior year balances have been reclassified to conform with the current year's presentation.

NASA prepares its financial statements in accordance with the following hierarchy of accounting principles, standards, and requirements:

- Accounting principles, standards, and requirements recommended by the Federal Accounting Standards Advisory Board; approved by the Director of the Office of Management and Budget (OMB), the Comptroller General of the United States, and the Secretary of the Treasury; and concurrently issued by OMB and the General Accounting Office (GAO).
- Interpretations related to the standards issued by OMB in accordance with the procedures outlined in OMB Circular No. A-134, "Financial Accounting Principles and Standards."
- Reporting requirements in OMB Bulletin No. 97-01, "Form and Content of Agency Financial Statements," as amended.
- Accounting principles published by other authoritative standard setting bodies and other authoritative sources.

**Implementation of New Accounting Standards**

NASA implemented the provisions of four accounting standards effective October 1, 1997.

- (1) Statement of Federal Financial Accounting Standards (SFFAS) No. 4, "Managerial Cost Accounting Concepts and Standards for the Federal Government," which requires reporting of NASA programs on a full cost basis.

- (2) SFFAS No. 6, "Accounting for Property, Plant, and Equipment." Major changes include recognizing depreciation on general property, plant, and equipment; disclosing deferred maintenance on those assets; and writing-off assets that no longer provide service in NASA operations. In response to this standard, NASA has capitalized a new category of assets, "Assets in Space," the costs of which had been previously treated as an expense in the period incurred.
- (3) SFFAS No. 7, "Accounting for Revenue and Other Financing Sources and Concepts for Reconciling Budgetary and Financial Accounting." NASA has begun using full cost pricing in its reimbursable activities.
- (4) SFFAS No. 8, "Supplementary Stewardship Reporting." NASA is reporting part of its property, plant, and equipment as "Heritage Assets" and is reporting its overall investment in research and development as a component of its Required Supplementary Stewardship Information.

#### **Budgets and Budgetary Accounting**

NASA is funded by three appropriations that require individual treatment in the NASA accounting and control system. Reimbursements to NASA's appropriations total approximately \$700 million annually. As part of its reimbursable program, NASA launches devices into space and provides tracking, station keeping and data relay for the U.S. Department of Defense, the National Oceanic and Atmospheric Administration, and the National Weather Service.

On the Statement of Budgetary Resources, Unobligated Balances-Available represent the amount remaining in appropriation accounts, that is available for obligation in the next fiscal year. Unobligated Balances-Not Available represent the amount remaining in appropriation accounts that can only be used for adjustments to previously-recorded obligations.

#### **Fund Balance With Treasury**

NASA's cash receipts and disbursements are processed by the U.S. Department of the Treasury. Fund Balance With Treasury includes appropriated funds, trust funds, and deposit funds for advances received for reimbursable services.

#### **Investments in U. S. Government Securities**

NASA's intragovernmental non-marketable securities include the following investments:

- (1) National Aeronautics and Space Administration Endeavor Teacher Fellowship Trust Fund established from public donations in tribute to the crew of the Space Shuttle Challenger.
- (2) Science Space and Technology Education Trust Fund established from public donations for programs to improve science and technology education.

#### **Accounts Receivable**

Most receivables are due from other Federal agencies for reimbursement of research and development services related to satellites and launch services. Non-federal customers provide advance payments placed on deposit with the U. S. Department of the Treasury until services are performed. The allowance for uncollectible accounts is based upon each NASA Center's evaluation of its individual accounts receivable, considering the probability of failure to collect based upon current status, financial and other relevant characteristics of debtors, and the relationship with the debtor. Under a cross-servicing arrangement, accounts receivable over 180 days delinquent are turned over to the U.S. Department of the Treasury for collection.

### **Advances**

NASA provides funds to its recipients under the University Contracts and Grants Program by draw-downs on letters of credit or through the use of predetermined payment schedules. Recipients are required to schedule drawdowns to coincide with actual, immediate cash requirements, in accordance with U.S. Department of the Treasury regulations. Quarterly reporting by recipients to NASA is provided on Federal Cash Transaction Reports (SF 272). The California Institute of Technology, which manages NASA's Jet Propulsion Laboratory, is a major recipient of funds under letter of credit procedures. Detailed monitoring and accountability records are maintained. Monitoring includes audits by the Defense Contract Audit Agency (DCAA) and NASA's Office of the Inspector General.

### **Prepaid Expenses**

Payments in advance of the receipt of goods and services are recorded as prepaid expenses at the time of prepayment and recognized as expenses when related goods and services are received.

### **Operating Materials and Supplies**

In accordance with SFFAS No. 3, "Accounting for Inventory and Related Property," materials held by NASA Centers that are repetitively procured, stored, and issued on the basis of demand are considered Operating Materials and Supplies.

### **Property, Plant, and Equipment**

NASA-owned property, plant, and equipment is held by the agency and its contractors and grantees. With its implementation of SFFAS No. 6, NASA raised its \$5,000 threshold for capitalizing general property, plant, and equipment. Effective October 1, 1997, property with a unit cost of \$100,000 or more and a useful life of two years or more is capitalized; all other property is expensed when purchased. Capitalized cost includes all costs incurred by NASA to bring the property to a form and location suitable for its intended use. The change in threshold resulted in a reduction of \$3 billion in the amount previously reported for NASA's property, plant, and equipment. NASA continues to maintain physical accountability for all property, plant, and equipment regardless of cost.

Under provisions of the Federal Acquisition Regulation (FAR), contractors are responsible for control over and accountability for Government-owned property in their possession. NASA's contractors and grantees report on NASA property in their custody annually.

Previously, NASA did not recognize depreciation of its assets. In accordance with SFFAS No. 6, these financial statements report depreciation expense, calculated using the straight-line method. As a result, accumulated depreciation of \$3 billion was recorded for NASA's real property, \$6 billion was recorded for equipment, and \$10 billion was recorded for assets in space as of October 1, 1997. Useful lives were established as follows: 40 years for buildings; 15 years for other structures and facilities; 15 years for space hardware; 7 years for special test equipment and tooling; 5 to 20 years for other equipment dependent upon its nature; and 25 years for the Space Shuttle Orbiters. Useful lives for assets in space are generally their basic mission lives, ranging from 2 to 20 years.

In accordance with the new accounting standards, NASA removed the cost of heritage assets, totaling \$341 million, from its Statement of Financial Position. Heritage assets are now summarized as supplementary stewardship information.

### **Liabilities Covered by Budgetary Resources**

Accounts payable includes amounts recorded for receipt of goods or services furnished to the Agency, based on billings rendered. Additionally, NASA accrues cost and recognizes liabilities based on information provided monthly by contractors on NASA Contractor Financial Management Reports (NASA Forms (NF) 533M and Q). NASA relies on independent audits by the DCAA to ensure reliability of reported costs and estimates. To provide further assurance, financial managers

are required to test the accuracy of cost accruals generated from the NF 533s monthly, and NASA Headquarters independently analyzes the validity of Centers' data.

#### **Liabilities Not Covered by Budgetary Resources**

NASA's liabilities not covered by budgetary resources include certain environmental matters, legal claims, pensions and other retirement benefits, workers' compensation, annual leave (see discussion below) and closed appropriations.

NASA liabilities not covered by budgetary resources consist primarily of environmental cleanup costs as required by Federal, state, and local statutes and regulations. NASA uses parametric models to estimate the total cost of cleaning up these sites over future years. The estimates also include a five-year operational period within the remedial action phase and Centers were required to indicate the exact number of years if different than five years. In addition, a five-year monitoring period was added to the estimate for ground water, surface water/sediment, and ecological monitoring. This year, NASA estimates the total cost of this cleanup to be \$1.4 billion, and has recorded an unfunded liability in its financial statements for that amount. This estimate could be affected in the future by changes due to inflation, deflation, technology, or applicable laws and regulations. The \$1.4 billion represents an estimate of the amount that NASA will spend to remediate the currently known sites, subject to the availability of appropriated funds. Other responsible parties that may be required to contribute to the remediation funding could share this liability. In FY 1998, NASA was appropriated \$11 million for environmental compliance and restoration. Included in the \$1.4 billion liability is \$22 million for cleanup of current operations as required by SFFAS No. 6.

NASA is a party in various administrative proceedings, court actions (including tort suits), and claims brought by or against it. In the opinion of NASA management and legal counsel, the ultimate resolution of these proceedings, actions, and claims will not materially affect the financial position or results of NASA. NASA accrued \$68 million for these matters as of September 30, 1998. The Judgement Fund will be the source of payment for \$31 million of this estimate.

NASA contingencies where it is possible but not probable that some cost will be incurred range from zero to \$13 million, as of September 30, 1998. Accordingly, no balances have been recorded in the financial statements for these contingencies.

Additionally, NASA has recorded a liability for \$66 million, as of September 30, 1998, for workers' compensations claims related to the Federal Employees' Compensation Act (FECA), which is administered by the U.S. Department of Labor (DOL). FECA provides income and medical cost protection to covered Federal civilian employees injured on the job, employees who have incurred a work-related occupational disease, and beneficiaries of employees whose death is attributable to a job-related injury or occupational disease. The FECA program initially pays valid claims and subsequently seeks reimbursement from the Federal agencies employing the claimants.

This liability includes \$51 million of estimated future costs of death benefits, workers' compensation, and medical and miscellaneous costs for approved compensation cases. This liability does not include the estimated future costs for claims incurred but not reported and/or approved at September 30, 1998. The present value of these estimates at the end of FY 1998 was calculated by DOL using a discount rate of 5.60 percent for FY 1999 and thereafter.

NASA also recorded a \$36 million estimate of obligations related to canceled appropriations for which there is a contractual commitment for payment.

**Annual, Sick, and Other Leave**

Annual leave is accrued as it is earned; the accrual is reduced as leave is taken. Each year, the balance in the accrued annual leave account is adjusted to reflect current pay rates. To the extent current or prior year appropriations are not available to fund annual leave earned but not taken, funding will be obtained from future financing sources. Sick leave and other types of non-vested leave are expensed as taken.

**Employee Benefits**

NASA's employees participate in the Civil Service Retirement System (CSRS), a defined benefit plan, or the Federal Employees Retirement System (FERS), a defined benefit and contribution plan. For CSRS employees, NASA makes matching contributions equal to seven percent of pay. For FERS employees, NASA automatically contributes one percent of pay to a retirement savings plan and matches employee contributions up to an additional four percent of pay. For FERS employees, NASA also contributes the employer's matching share for Social Security.

SFFAS No. 5, "Accounting for Liabilities of the Federal Government," requires government agencies to report the full cost of employee benefits for the Civil Service Retirement System (CSRS), Federal Employees Retirement System (FERS), Federal Employee Health Benefit (FEHB), and Federal Employees Group Life Insurance (FEGLI) programs. NASA used the applicable cost factors and imputed financing sources from the Office of Personnel Management (OPM) Financial Management Letter F-98-07 in NASA's financial statements.

## 2. Fund Balance With Treasury:

(In Thousands)

Fund Balances:	Obligated	Unobligated Available	Unobligated Restricted	Total
Appropriated Funds	\$ 5,264,456	\$ 785,816	\$ 112,193	\$ 6,162,465
Trust Funds	0	0	727	727
Total	\$ 5,264,456	\$ 785,816	\$ 112,920	\$ 6,163,192
Deposit Funds				102,522
Clearing Accounts				(9,707)
Total Fund Balance With Treasury				\$ 6,256,007

Obligated balances represent the cumulative amount of obligations incurred, which are supported by documentary evidence, for which outlays have not yet been made. Unobligated available balances represent the amount remaining in appropriation accounts that are available for obligation in the next fiscal year. Unobligated restricted balances represent the amount remaining in appropriation accounts that can only be used for adjustments to previously-recorded obligations. Unobligated restricted trust fund balances represent amounts that must be apportioned by the Office of Management and Budget before being used to incur obligations.

## 3. Investments:

(In Thousands)

	Par Value	Amortization Method	Discount, Net	Net Investments
Intragovernmental Non-marketable Securities	\$ 16,880	Interest method	\$ (121)	\$ 16,759

Intragovernmental securities are non-marketable Treasury securities issued by the Bureau of Public Debt and are purchased and redeemed at par.

Interest rates range from four percent to nine percent and individual bonds mature during FY 1999.

## 4. Accounts Receivable, Net:

(In Thousands)

	Entity Accounts Receivable	Non-entity Accounts Receivable	Allowance for Uncollectible Receivables	Net Amount Due
Intragovernmental	\$ 152,874	\$ 1,023	\$ (72)	\$ 153,825
Governmental	1,101	4,476	(915)	4,662
Total	\$ 153,975	\$ 5,499	\$ (987)	\$ 158,487

Non-entity accounts receivable represent amounts that will be deposited to miscellaneous receipts when collected and subsequently returned to the U.S. Department of the Treasury.

## 5. Operating Materials and Supplies:

(In Thousands)

		Valuation Method
Stores Stock	\$ 2,277,765	Weighted Avg.
Standby Stock	2,812	Weighted Avg.
Total	<u>\$ 2,280,577</u>	

Stores stock represents material being held in inventory which is repetitively procured, stored, and issued on the basis of recurring demand. Standby stock represents material held for emergencies. These amounts are held for use in current operations. Excess, obsolete, and unserviceable items have been removed from these amounts.

## 6. Property, Plant, and Equipment:

(In Thousands)

	Cost	Accumulated Depreciation	Net Asset Value
Government-owned/Government-held:			
Land	\$ 112,746	\$ 0	\$ 112,746
Structures, Facilities, and Leasehold Improvements	4,970,932	(2,995,690)	1,975,242
Assets in Space	16,700,500	(11,915,983)	4,784,517
Equipment	1,618,968	(439,107)	1,179,861
Work in Process	2,659,596	0	2,659,596
Total	<u>26,062,742</u>	<u>(15,350,780)</u>	<u>10,711,962</u>
Government-owned/Contractor-held:			
Land	11,778	0	11,778
Structures, Facilities, and Leasehold Improvements	730,142	(440,014)	290,128
Equipment	9,989,263	(5,476,960)	4,512,303
Work in Process	5,841,488	0	5,841,488
Total	<u>16,572,671</u>	<u>(5,916,974)</u>	<u>10,655,697</u>
Total Property, Plant, and Equipment	<u>\$ 42,635,413</u>	<u>\$ (21,267,754)</u>	<u>\$ 21,367,659</u>

Assets in Space are various spacecraft which operate above the atmosphere for exploration purposes. This is a new category of assets which had previously been treated as an expense. Equipment includes special tooling, special test equipment, and space hardware, such as the Space Shuttle, and other configurations of spacecraft: engines, unlaunched satellites, rockets, and Space Station and other scientific components unique to NASA space programs. Structures, Facilities, and Leasehold improvements include buildings with collateral equipment, and capital improvements such as airfields, power distribution systems, flood control, utility systems, roads, and bridges. NASA also has use of certain properties at no cost. These properties include land at the Kennedy Space Center withdrawn from the public domain and land and facilities at the Marshall Space Flight Center under a no cost, 99-year lease with the U.S. Department of the Army. Work-in-Process is the cost incurred for property, plant, and equipment items not yet completed.

## 7. Other Liabilities:

(In Thousands)

### Liabilities Covered by Budgetary Resources:

#### Intragovernmental Liabilities:

Liability for Deposit and Suspense Funds	\$ 18,529
Total Intragovernmental	<u>\$ 18,529</u>

#### Governmental Liabilities:

Liability for Deposit and Suspense Funds	\$ 74,892
Accrued Payroll and Benefits	88,411
Lease Liabilities	178
Total Governmental	<u>\$ 163,481</u>

All liabilities covered by budgetary resources are current. The liability for deposit and suspense funds includes cash advances received from other Government agencies and public reimbursable customers. Also included are funds on deposit with the U.S. Department of the Treasury for employees' savings bonds and state tax withholdings. See Note 1 for further discussion of liabilities covered by budgetary resources.

### Liabilities Not Covered by Budgetary Resources:

	Current	Non-current	Total
Intragovernmental Liabilities:			
Accounts Payable for			
Closed Appropriations	\$ 15	\$ 2,176	\$ 2,191
Liability for Receipt Accounts	450	0	450
Workers' Compensation	7,128	7,389	14,517
Total Intragovernmental	<u>\$ 7,593</u>	<u>\$ 9,565</u>	<u>\$ 17,158</u>
Governmental Liabilities:			
Accounts Payable for			
Closed Appropriations	\$ 2,563	\$ 31,018	\$ 33,581
Contingent Liabilities	5,825	62,443	68,268
Unfunded Annual Leave	0	133,421	133,421
Liability for Receipt Accounts	3,424	0	3,424
Lease Liabilities	0	500	500
Total Governmental	<u>\$ 11,812</u>	<u>\$ 227,382</u>	<u>\$ 239,194</u>

See Note 1 for further discussion of liabilities not covered by budgetary resources.

## 8. Leases:

(In Thousands)

Entity as Lessee:

Capital Leases:

Summary of Assets Under Capital Lease:

Equipment	\$ 4,475
Accumulated Amortization	\$ 3,797

NASA capital leases consist of assorted ADP and copier equipment with non-cancelable terms longer than one year, a fair market value of \$100,000 or more, a useful life of two years or more and agreement terms equivalent to an installment purchase.

Future Lease Payments:	<u>Fiscal Year</u>	
	1999	\$ 320
	2000	295
	2001	254
	2002	93
	2003	23
	2004 and after	0
	Future Lease Payments	985
	Less: Imputed Interest	(307)
	Net Capital Lease Liability	<u>\$ 678</u>

Liabilities Covered by Budgetary Resources	\$ 178
Liabilities Not Covered by Budgetary Resources	500
Total	<u>\$ 678</u>

Operating Leases:

NASA's one operating lease is for an airplane hangar with a non-cancelable period in excess of one year.

Future Lease Payments:	<u>Fiscal Year</u>	
	1999	\$ 239
	2000	140
	2001	140
	Total	<u>\$ 519</u>

Entity as Lessor:

Operating Leases:

NASA leases and allows use of its land, facilities, and equipment by the public and other Government agencies for a fee.

Future Projected Receipts:	<u>Fiscal Year</u>	
	1999	\$ 165
	2000	197
	2001	163
	2002	163
	2003	147
	2004 and after	120
	Total	<u>\$ 955</u>

**9. Unexpended Appropriations:**  
(In Thousands)

	Appropriated Funds
Unexpended Appropriations:	
Undelivered Orders	\$ 2,218,810
Unobligated:	
Available	785,816
Unavailable	112,193
Total	<u>\$ 3,116,819</u>

**10. Gross Cost and Earned Revenue by Budget Functional Classification:**  
(In Thousands)

Functional Classification	Gross Cost	Earned Revenue	Net Cost
General Science, Space, and Technology	\$ 13,453,928	\$ 664,016	\$ 12,789,912
Transportation	1,427,325	51,391	1,375,934
Costs Not Assigned to Programs	(35,043)	0	(35,043)
Trust Funds	1,457	0	1,457
Total	<u>\$ 14,847,667</u>	<u>\$ 715,407</u>	<u>\$ 14,132,260</u>

**11. Prior Period Adjustments:**  
(In Thousands)

Classification of Prior Period Adjustment

Assets in Space	\$ 16,474,000
Accumulated Depreciation-Assets in Space	(10,426,282)
Accumulated Depreciation-Equipment	(6,037,378)
Accumulated Depreciation-Structures, Facilities, and Leasehold Improvements	(3,358,636)
Change in Capitalization Threshold-Equipment	(2,486,142)
Change in Capitalization Threshold-Structures, Facilities, and Leasehold Improvements	(525,230)
Heritage Assets	(341,192)
Other	632,350
Total Prior Period Adjustments	<u>\$ (6,068,510)</u>

Statements of Federal Financial Accounting Standards No. 6, "Accounting for Property, Plant, and Equipment," and No. 8, "Supplementary Stewardship Reporting," were implemented in fiscal year 1998. Implementation included recognition of assets in space, depreciation of capitalized assets, write-offs of assets not in use, and reporting heritage assets as Required Supplementary Stewardship Information. As part of its implementation, NASA increased the capitalization threshold for general property, plant, and equipment from \$5,000 to \$100,000; property of lesser value was recorded as a reduction to prior year asset values and current year amounts less than \$100,000 were expensed.

## 12. Deferred Maintenance:

NASA has deferred maintenance only on its facilities, including structures, leasehold improvements, and assets under capital lease. NASA has no significant deferred maintenance on other physical property, such as land, equipment, assets in space, or work-in-process. NASA contractor-held property is subject to the same considerations.

NASA uses the condition assessment survey method for facilities to determine asset condition and maintenance required. Several standards are used for evaluating facility condition: (1) 100 percent inspection and condition assessment on a five-year cycle; (2) metrics to support long-term trend analyses; and (3) application of industry standards. Further, in 1997, NASA conducted a NASA-wide Facility Investment Study to identify future repairs and maintenance activities throughout the agency. NASA defines acceptable operating condition in accordance with standards comparable to those used in private industry, including the aerospace industry.

The level of acceptable condition of an asset is commensurate with the requirements of the using program or mission. NASA has made no changes to its condition assessment standards in the past several years. NASA's estimate of its backlog of maintenance and repair is approximately \$1.4 billion. This estimate was derived from the 1997 NASA-wide Facility Investment Study and was adjusted as of September 30, 1998, to reflect inflation and the amounts budgeted to correct existing facility deficiencies.

NASA also included deferred maintenance related to heritage assets. NASA does not defer maintenance on assets that require immediate repair to restore them to safe working condition.

**National Aeronautics and Space Administration  
Required Supplementary Stewardship Information  
Heritage Assets  
for the Fiscal Year Ended September 30, 1998**

Fiscal Year 1998 was the first year Federal agencies were required to classify and report heritage assets, in accordance with the requirements of Statement of Federal Financial Accounting Standards No. 8, "Supplementary Stewardship Reporting."

Heritage assets are property, plant, and equipment that possess one or more of the following characteristics: historical or natural significance; cultural, educational or aesthetic value; or significant architectural characteristics.

Since the cost of heritage assets is not often relevant or determinable, NASA does not attempt to value them or to establish minimum value thresholds for designation of property, plant, or equipment as heritage assets. The useful lives of heritage assets are not reasonably estimable for depreciation purposes.

Since the most relevant information about heritage assets is their existence, they are reported in terms of physical units, as follows:

Buildings and structures	20
Air and space displays and artifacts	103
Miscellaneous items	<u>6</u>
Total heritage assets	<u>129</u>

NASA heritage assets are considered collectible, except for its fixed assets. Heritage assets were generally acquired through construction by NASA or its contractors, and are expected to remain in this category, except where there is legal authority for transfer or sale. NASA's heritage assets are generally in fair condition, suitable only for display.

Many of the buildings and structures are designated as National Historic Landmarks. Numerous air and spacecraft and related components are on display at various locations to enhance public understanding of NASA programs. The heritage assets reported by NASA were previously recorded on the Property, Plant, and Equipment line item of the Statement of Financial Position. NASA eliminated its estimated cost from its property records when they were designated as heritage assets. A portion of the deferred maintenance reported in Note 12 is for heritage assets.

National Aeronautics and Space Administration  
Required Supplementary Stewardship Information  
Stewardship Investments: Research and Development  
for the Fiscal Year Ended September 30, 1998  
(In Thousands)

**Program/Application:**

**Space Station**

Applied Research	\$ 137,529
Development	2,362,996
	<u>2,500,525</u>

**Payload Utilization and Operations**

Applied Research	401,528
	<u>401,528</u>

**Life and Microgravity**

Basic	221,217
Applied Research	157,727
Development	20,365
	<u>399,309</u>

**Space Science**

Basic	1,049,037
Applied Research	429,895
Development	857,453
	<u>2,336,385</u>

**Earth Science**

Basic	331,095
Applied Research	156,835
Development	1,254,677
	<u>1,742,607</u>

**Aeronautics Research and Technology**

Basic	438,923
Applied Research	937,011
	<u>1,375,934</u>

**Space Access and Technology**

Applied Research	678,036
	<u>678,036</u>

**Commercial Programs**

Applied Research	98,198
Development	45,788
	<u>143,986</u>

**Mission Communication Services**

Development	444,933
	<u>444,933</u>

**Academic Programs**

Basic	90,468
Applied Research	19,481
Development	37,634
	<u>147,583</u>

<b>Total Research and Development Expenses by Program</b>	<b>\$ 10,170,826</b>
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**National Aeronautics and Space Administration  
Required Supplementary Stewardship Information  
Stewardship Investments: Research and Development  
for the Fiscal Year Ended September 30, 1998  
(In Thousands)**

**Program/Application (continued):**

**Non-Research and Development Expenses by Program**

Space Shuttle	\$ 3,369,846
Space Communication Services	254,440
U.S./Russian Cooperative	152,625
Other Programs	218,109

<b>Trust Funds</b>	1,457
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<b>Reimbursable Expenses</b>	715,407
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<b>Total Non-Research and Development Expenses by Program</b>	<u>\$ 4,711,884</u>
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<b>Total Program Expenses</b>	<u><u>\$14,882,710</u></u>
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NASA makes substantial research and development investments for the benefit of the Nation. These amounts are expensed as incurred in determining the net cost of operations.

NASA's research and development programs include activities to extend our knowledge of the Earth, its space environment, and the universe, and to invest in new aeronautics and advanced space transportation technologies which support the development and application of technologies critical to the economic, scientific, and technical competitiveness of the United States.

See Management's Discussion and Analysis for detailed program descriptions and output and outcome measures.

# List of Acronyms

AAVOS	All Aircraft Vortex Spacing System	ISO	International Standards Organization
ADP	Automated Data Processing	ISS	International Space Station
ADR	Alternative Dispute Resolution	IT	Information Technology
AGATE	Advanced General Aviation Transport Experiments	JPL	Jet Propulsion Laboratory
AMS	Alpha Magnetic Spectrometer	JSC	Johnson Space Center
ARC	Ames Research Center	KSC	Kennedy Space Center
AST	Aero-space Technology Enterprise	LaRC	Langley Research Center
AXAF	Advanced X-ray Astronomy Facility	LeRC	Lewis Research Center
CAS	Computational Aerosciences	LOX	Liquid Oxygen
CC-ROM	Compact Disk-Read Only Memory	MEIT	Multi Element Integration Testing
CFO	Chief Financial Officer	MSFC	Marshall Space Flight Center
CheX	Confined Helium Experiment	NACC	NASA ADP Consolidation Center
CIO	Chief Information Officer	NDE	Non-Destructive Evaluation
CLF	Civilian Labor Force	NISN	NASA Integrated Services Network
COTS	Commercial Off the Shelf	NIX	NASA Image EXchange
CSRS	Civil Service Retirement System	NOA	New Obligational Authority
DAAC	Distributed Active Archive Centers	NOX	Nitrogen Oxide
DCAA	Defense Contract Audit Agency	NPD	NASA Planning Document
DFRC	Dryden Flight Research Center	NSTAR	NASA Solar Electric Propulsion Technology Applications Readiness
DOD	Department of Defense	ODIN	Outsourcing Desktop Initiative
DOL	Department of Labor	OEOP	Office of Equal Opportunity Programs
EEOC	Equal Employment Opportunity Commission	OIG	Office of Inspector General
ELV	Expendable Launch Vehicle	OLMSA	Office of Life and Microgravity Science
ES	Earth Science Enterprise	OMB	Office of Management and Budget
FAA	Federal Aviation Administration	OPM	Office of Personnel Management
FAR	Federal Acquisition Regulation	PAPAC	Provide Aerospace Products and Capabilities
FASAB	Federal Accounting Standards Advisory Board	PBC	Performance Based Contracting
FECA	Federal Employees Compensation Act	PBS	Plumbrook Station
FEGLI	Federal Employee Group Life Insurance	PCA	Program Commitment Agreements
FEHB	Federal Employee Health Benefit	PRP	Potentially Responsible Parties
FERS	Federal Employees Retirement System	R&D	Research and Development
FFMIA	Federal Financial Management Improvement Act	RIF	Reduction in Force
FFRDC	Federally Funded Research and Development Center	SeaWIFS	Sea-viewing Wide Field Sensor
FMFIA	Federal Managers' Financial Integrity Act	SF	Standard Form
FOIA	Freedom of Information Act	SFOC	Space Flight Operations Contract
FTE	Full Time Equivalent	SLWT	Super Light Weight Tank
FY	Fiscal Year	SM	Service Module
GAO	General Accounting Office	SRB	Solid Rocket Booster
GLOBE	Global Learning Observations for a Better Environment	SS	Space Science Enterprise
GSFC	Goddard Space Flight Center	SSC	Stennis Space Center
HEDS	Human Exploration and Development of Space	SSFAS	Statement of Federal Financial Accounting Standards
HSCT	High Speed Civil Transport	SSME	Space Shuttle Main Engine
IFMP	Integrated Financial Management Project	STI	Scientific and Technical Information Program
IPA	Independent Public Accountant	STS	Space Transportation System
IPCC	Intergovernmental Panel on Climate Change	TOMS	Total Ozone Mapping Spectrometer
		TOPEX	Ocean TOPography EXperiment
		TRACE	Transition Region and Coronal Explorer
		TRMM	Tropical Rainfall Measuring Mission
		USAF	United States Air Force
		WFF	Wallops Flight Facility

## Notes

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